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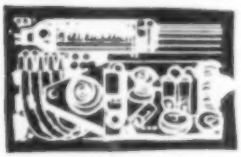

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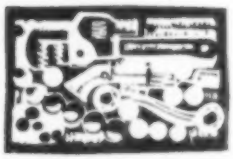

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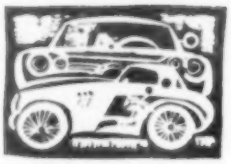

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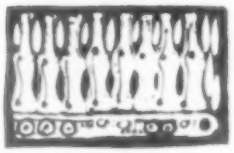

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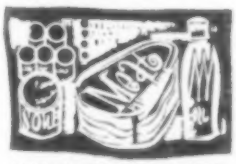

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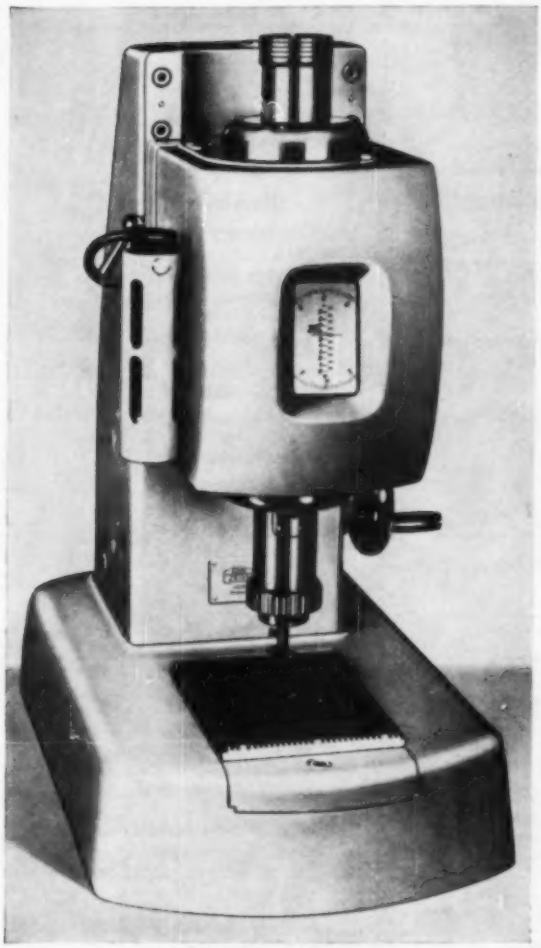

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INDUSTRIAL QUALITY CONTROL

Vol. XVII, No. 8 February, 1961

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National Bureau of Standards **823:60;70:400**
Consequences of applying acceptance sampling procedures which assume an exponential failure law when actually the failure law is the Weibull distribution has been investigated at the National Bureau of Standards. It was found that these widely used statistical techniques are very sensitive to departures from initial assumptions.

8 **Data Fun—Data Frustration—Data Failure**
C. GADZINSKI **730:10;70:000**
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10 **Automatic Production Recording—Yield—And Quality Control**
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14 **Applications of Industrial Statistics in Research and Development**
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17 **Intercomparison of Laboratory Test Methods**
National Bureau of Standards **500:70:000**
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From the President's Desk

Professional Development and Personal Advancement

If you are interested in personal advancement, you probably noted the ten (10) advertisements in your November IQC—all seeking professional quality control engineers to fill important vacancies. Openings for more than thirty (30) qualified persons were indicated.

Business analysts and industrialists indicate that the requirements for professional men—engineers and technicians—must, and will, multiply during the 1960-70 decade.

A sampling investigation of our membership indicates that over 62 percent of our ASQC members now have management or supervisory positions; more than 50 percent have engineering degrees.

Many of these members advanced in their education and in their companies concurrently with active participation in related ASQC programs.

Your Professional Development Committee, under the cognizance of Vice President A. V. Feigenbaum and Chairman Wyatt Lewis, is now completing a three year study and delineation of all important quality control work elements; and a plan for examining, licensing, and/or certifying those who qualify as Professional Quality Control Engineers. This program will help both college graduate and non-graduate personnel to secure appropriate training, and valuable recognition and identification in their profession.

Our ASQC Education and Training Institute is now intensifying plans for the coordination and implementation of training throughout the Society. The ASQC Workshop Seminars and ASQC-IRE Reliability Seminars now being held are receiving national recognition and acclaim.

In spite of all this effort and advancement by many, there are still ASQC members who hesitate to advance to higher member grades. Some doubt the value—others believe that they are saving a few dollars per year.

I hope that you are not one of these, but are taking full advantage of your membership in the American Society for Quality Control to grow in professional stature and personal advancement.

Jay McClure

Are Statistical Life-Testing Procedures Robust?

How Well Do Statistical Life Testing Procedures Work When the Exponential Assumption Is Not Satisfied?

Summary Technical Report, November, 1960

National Bureau of Standards, Washington, D.C.

A study of the behavior of several statistical life-testing procedures investigated the consequences of applying acceptance sampling procedures which assume an exponential failure law when actually the failure law is the Weibull distribution. It was found that these widely used statistical techniques are very sensitive to departures from initial assumptions.

The National Bureau of Standards has been evaluating the robustness of acceptance sampling procedures used in life-testing experiments. Procedures which can be used effectively when some of the underlying mathematical assumptions are not satisfied are termed robust. Recently, M. Zelen and M. C. Dannemiller of the Bureau's Statistical Engineering Laboratory made a study of four acceptance sampling plans[1] that are representative of life-testing procedures currently used in the electronics industry.

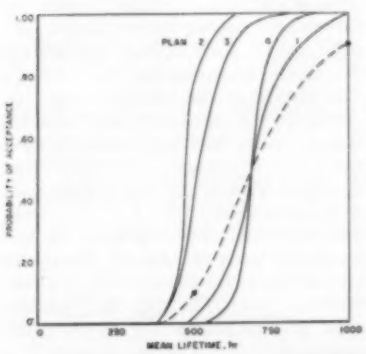

Figure 1—Operating characteristic (OC) curves were computed at the National Bureau of Standards for four acceptance sampling plans based on the exponential distribution when the failure times actually follow a particular Weibull distribution. If the exponential distribution applies, components having mean lifetimes of 1000 and 500 hours are accepted with probabilities of 0.90 and 0.10, respectively. This is illustrated by the dashed line, which is the OC curve for plan 3 when the failure times come from an exponential distribution.

Almost all statistical life-testing techniques are based on the assumption that the times to failure of components in a life test follow the exponential distribution. Since in practice the probability distribution of failure times may not be exponential, it is important to determine the robustness properties of these statistical life-testing procedures; i.e., how well the procedures work when the exponential assumption is not satisfied. Robust procedures are particularly desirable in reliability prediction because the underlying mathematical properties of the observed phenomena may not be known.

The successful operation of any complex system is dependent upon the operation of each individual component in the system. Thus if components from a manufactured lot are to be incorporated into an electronic system, it is essential that a large proportion of the items have a minimum acceptable lifetime. Unfortunately, it is seldom feasible to assess the lifetime of each component or of even a large proportion of the components. Furthermore, in many instances when components are subjected to a life test, the testing procedure is completely destructive. When an acceptance sampling technique is employed, only a sample of items from the lot undergoes life testing. The resulting data on failure times serve as a basis for accepting or rejecting the lot.

The amount of testing necessary for a particular acceptance sampling plan depends on:

(1) The probability of rejecting components having the desired average or mean failure time (producer's risk);
(2) the probability of accepting components having a specified below-par mean failure time (consumer's risk).

These probabilities are assigned so as to safeguard both the producer's and the consumer's interests. The consumer desires that the chance of accepting poor quality items be small; while the producer must be reasonably sure that good items will not be rejected. There is no guarantee, however, that the assigned risk levels will be maintained if the exponential assumption is false. If these risks are appreciably altered, the application of the acceptance sampling procedure may be disastrous to either the producer or the consumer.

The four acceptance sampling plans which were investigated for robustness properties are:

(1) fixed sample size plan — a sample of n components is tested until all fail;
(2) fixed sample size plan with censoring — a sample of n components is placed on test, and testing is discontinued after the r^{th} failure $(r < n)$;
(3) truncated nonreplacement plan — a sample of n components is placed on test and the testing discontinued after a preassigned time;
(4) simple sequential plan —

the components are placed on test one at a time, and after each failure a decision is made to accept the lot, reject the lot, or continue testing.

For any one of these acceptance sampling plans, the operating characteristic (OC) curve can be constructed depicting the mean failure time plotted against the probability of acceptance. This curve is well known when the distribution of failure times is exponential. If it can be shown that the operating characteristic curve is not appreciably changed when the failure times actually come from certain alternative distributions, then the sampling procedure is said to be robust with respect to the alternative distributions.

Three Weibull distributions with different shape parameters were chosen as alternative distributions for studying the robustness of the four acceptance sampling plans. The Weibull distribution belongs to a class of distributions which characterize "wear out" failure, e.g., the longer the item has been in operation, the greater the probability of failure. Further, it is difficult to distinguish between it and the exponential distribution for small sample sizes. This latter fact has special significance because the experimenter will rarely have enough data to enable him to decide which distributional assumption holds.

The exact operating characteristic curves for plan three were obtained from known theoretical results. On the other hand, the OC curves for plans one and four were calculated using special analytical approximations developed in the Bureau's Statistical Engineering Laboratory. The OC Curve for plan two was calculated by simulating several thousands of life-test experiments on a computer.

The operating characteristic curves indicate that not one of the four acceptance sampling procedures is robust with respect to Weibull alternative distributions. The fixed sample size plan with censoring (2) and the truncated nonreplacement plan (3) are strikingly nonrobust because the particular choice of Weibull distributions in this study, components having a low mean failure time showed a high probability of acceptance. On the other hand, the fixed sample size plan (1) and the sequential plan (4), while not robust, are less sensitive to departures from the exponential assumption.

The Bureau's study demonstrates dramatically the risks taken by an experimenter who adopts an acceptance sampling procedure without possessing sufficient knowledge of the underlying properties of the observed phenomena. The results further indicate the need for research leading to statistical methods for life testing that are insensitive to distributional assumptions. Development of robust methods is one of the goals of the Bureau's program of mathematical research into the prediction of the reliability of complex systems.[2]

1. For further information, see "The Robustness of Life Testing Procedures Derived from the Exponential Distribution," by M. Zelen and M. C. Dannemiller, *Technometrics* (to be published, February, 1961).
2. Mathematical research on reliability prediction, *NBS Tech. News Bulletin* 44, 24 (1960).

The official textbook for

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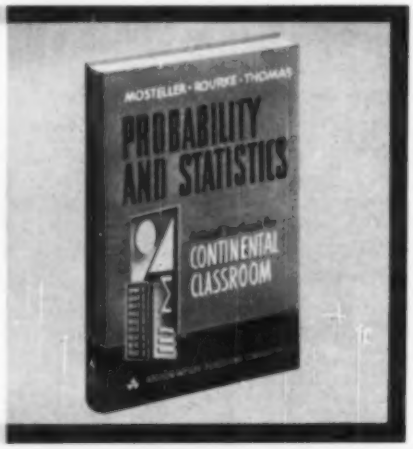

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Chapters 7 through 9, Lessons 34-48, Apr. 24-May 26, will appear in the March issue.

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Arrangements for the course were made by Paul C. Clifford, director of the ASQC Education and Training Institute, in cooperation with Dr. Frederick Mosteller, Harvard University. Mr. Clifford is a professor at Montclair State Teachers' College, Montclair, N.J.

For additional information, consult the January issue, *Industrial Quality Control*, pages 5-7, or contact Dr. John J. Kelley, National Coordinator, Continental Classroom, 680 Fifth Ave., New York 19, N.Y.

CHAPTER FOUR — General Theory of Probability for Finite Sample Spaces

In Chapter Three, using mostly intuition, we discover some general results about probabilities in sample spaces with equally likely outcomes. In this chapter, we adopt a more formal approach to probability. In particular, we deal also with probability in more general sample spaces whose outcomes are not equally likely. This new approach, with a slight modification, works in sample spaces for experiments with infinitely many outcomes, as we see in Chapter Six.

LESSON 17, Mar. 10 — From equally likely cases to more general models. Equally likely cases and real life. Outlook on future work. Examples: in which the possible outcomes are not equally likely: tossing a thumb-tack, oil-well drilling.

After a critical review of the probabilistic model based on equally likely outcomes, we study an experiment with two outcomes of unknown probability.

LESSON 18, Mar. 13 — Sample spaces and the assignment of probabilities. Going beyond equally likely cases: the axiomatic approach. Axioms for probability in finite sample spaces. Generalizing some earlier results.

At the level of generality that we desire in Chapter Four, it is no longer possible to define probability. Instead, we state three axioms or propositions that probabilities must satisfy. All other properties, several of which were approached intuitively in the previous chapter, have to be derived from the axioms by deduction.

LESSON 19, Mar. 15 — Independent events. Independence in two-by-two tables. Independence of three or more events. A surprising example. Pairwise independence. Complete independence.

The definition of independence of two events adopted in Chapter Three remains valid in our more general model. The extension of the idea of independence to more than two events presents some unexpected difficulties.

LESSON 20, Mar. 17 — Conditional Probability. Two approaches to conditional probability: by definition and as probability in a reduced sample space. Color blindness in males and females. Two-state Markov processes.

The results of Chapter Three on conditional probability suggest a way to introduce this important concept into our present model. For random phenomena developing in time, it is, in general, inappropriate to assume independence from one time point to another. The concept of conditional probability becomes of paramount importance in connection with such *stochastic processes*. The Markov process, of which we consider a special case, represents a simple, though nevertheless extremely important example of a stochastic process with applications to many fields in the physical and social sciences.

LESSON 21, Mar. 20 — The product rule and its uses. Assigning probability to compound events. Sampling with and without replacement.

The product rule is an immediate consequence of the notion of conditional probability. It permits us to compute the probability of compound events, events that can be expressed as the intersection of several simple events, as the product of successive conditional probabilities. If, as is often the case, conditional probabilities are easily found from calculations in appropriately reduced sample spaces, the product rule constitutes a useful tool in the solution of complex probabilistic problems.

LESSON 22, Mar. 22 — Bayes' theorem. *A priori* and *a posteriori* probabilities. Bayes' formula for the probability of causes. A subjective approach in scientific work.

A straightforward application of conditional probability leads to an important formula. The appropriate application of this formula has been one of the most controversial questions in applied mathematics. However, it is the foundation of our discussion of the personalistic approach to probability.

CHAPTER FIVE — Numbers Determined by Experiments — Random Variables

This chapter introduces one of the most fruitful concepts in probability and statistics: random variable. Closely related is another new concept: probability function. After defining and illustrating these two important ideas, we study methods of measuring location and variability for probability functions.

LESSON 23, Mar. 24 — Random variables and discrete probability functions. A random variable as a variable whose value is determined by the outcome of an experiment. The probability function of a random variable as the set of ordered pairs that associates with each possible value of the random variable its probability. Alternative ways of representing probability functions. Matching historical dates. Runs of occupied and unoccupied seats. Turning points in economic time series.

The concepts of a random variable and its probability function are basic for the remainder of the course. In this lesson, we define and illustrate both new ideas.

LESSON 24, Mar. 27 — Summations. Mathematical shorthand for summations. The Σ symbol and the use of subscripts. Some theorems about summations.

We interrupt our study of probability to discuss additional mathematical tools required in the sequel: the use of the summation symbol Σ.

LESSON 25, Mar. 28 — Mathematical expectation of a random variable. The sample average as a weighted sum of the sample frequencies. Mathematical expectation or population mean. The meaning of *expectation* in the probabilistic sense. Life insurance premiums. One-armed bandits.

For many practical as well as theoretical purposes, the mathematical expectation of a random variable is the most convenient single number that summarizes the information provided by the probability function of a random variable. Its basic significance derives from the law of large numbers (better known as the law of averages), which essentially

Food Quality Control Journal

The first issue of a new publication, *Food Quality Control*, was published in September by the ASQC Food and Allied Industries Division.

Two articles are "Quality Control of Packaged Food Products," by Hy Pitt, Oscar Mayer & Co., Madison, Wis., and "Quality Control in Sanitation," by William A. Golomski, H. J. Mayer & Sons Co., Inc., Chicago, Ill.

A few copies of this publication are still available. While they last ASQC members may obtain a copy by becoming a member of the Food and Allied Industries Division. Send your name, address, and one dollar to ASQC, 161 W. Wisconsin Ave., Milwaukee 3, Wis.

states that the average of a large number of observations on a random variable can be expected to be very close to the mathematical expectation of the random variable.

LESSON 26, Apr. 5 — Mean of a function of a random variable. Functions of random variables. Simplified computation of means of functions of random variables. The mean of a linear function. The first moment of random variable. The mean as a measure of "location" or "middle." Are successful gambling systems possible?

Often, an investigator is not primarily interested in the random variable immediately associated with his experiment. Rather, he may want to study a quantity that is functionally related to the actual observations. We investigate how one can find the mathematical expectations of functions of random variables.

LESSON 27, Apr. 7 — Variability. The meaning of spread or variability. Measures of variability: mean absolute deviation, variance, and standard deviation. Advantages of the variance. Computing formulas for the variance. The variance of a linear function of a random variable.

The expected value of a random variable gives information about the average result to be expected in an experiment that is repeated a large number of times. But it tells nothing about how outcomes spread out from one performance of the experiment to another. Variability of this kind can be measured in several ways. For many purposes, an appropriate measure of variability is the standard deviation (or the closely related variance).

LESSON 28, Apr. 10 — Average and variance in a sample. Averages and variance for sample observations as measures of location and spread. Relationship to theoretical measures.

The mathematical expectation and variance discussed in previous lessons refer to the underlying mathematical model or population. They do not directly provide the corresponding measures for the outcome of a specific experiment. Such measures are given by the sample average and variance.

LESSON 29, Apr. 12 — Chebyshev's theorem. Significance of the standard deviation as a measure of spread. A lower bound for the probability assigned by the distribution function of a random variable to symmetrical intervals about the mean. An empirical rule and Chebyshev's theorem.

Often students find it difficult to relate the notion of standard deviation to the notion of probability. Chebyshev's theorem offers an opportunity to establish such a connection.

CHAPTER SIX—Joint Distributions and Continuous Distributions

This chapter discusses two essentially unrelated topics that underlie much of the remaining work of the course: (1) joint distributions, dealing with the joint behavior of two or more random variables defined over the same sample space; (2) continuous distributions and their most important representative, the normal probability distribution.

LESSON 30, Apr. 14 — Joint probability functions of two random variables. Joint and marginal probability functions. Independence of two random variables. Mathematical expectation of a function of two random variables. Mean of a sum of random variables. Mean of a product of independent random variables.

It is often necessary to study the combined behavior of more than one random variable associated with the outcomes of the same experiment. Such a study requires knowledge of the probabilities of all possible joint occurrences (intersections), and leads at once to the concept of joint probability function. Earlier concepts relating to independence of events and mathematical expectation of a single variable find their natural generalizations.

LESSON 31, Apr. 17 — Probabilities as areas. Discrete and continuous distributions. Area probability graphs. Commuter probabilities.

The random variables discussed up to now have ordinarily had a finite number of possible values. In many problems, particularly in problems relating to physical measurements, it is convenient to think of infinitely many possible values, more exactly, a *continuum* of values. Under such circumstances it is no longer possible to assign positive probabilities to individual values. Instead we represent probabilities by area graphs.

LESSON 32, Apr. 19 — The normal distribution. The standard normal curve and its properties. Table of areas under the standard normal curve and its uses.

Theoretical as well as empirical considerations show that one type of probability distribution serves as an appropriate mathematical model for a large variety of problems: the normal probability distribution. In this lesson, we describe the standard normal probability distribution and show how to use it. In the following lesson, we discuss the importance of the normal probability distribution as a mathematical model, as well as the use of non-standard normal probability distributions.

LESSON 33, Apr. 21 — The normal distribution (continued). Importance of the normal curve: experimental and theoretical foundations. Transformation of non-standard normal variables. Another look at commuter probabilities.

... DATA FUN

WITH TODAY'S EMPHASIS on the control of overhead expenses we must take another look at some of the functions that are "nice to have" but are not really contributing to the profitability of the business. No place is this more true than in the area of quality control.

Within the last decade we have seen the development and application of statistical methods to the solution of manufacturing and engineering problems. These, after their one-shot success, are hanging on with no apparent economic justification. In other circumstances these techniques appear without any apparent requirement or understanding as to why they are needed, thus confusing those they are trying to assist.

If this sounds a bit far fetched, look around your own organization. How many people are involved in statistical computations, i.e. not only in the application of statistical method but in the accumulation of data? How many control charts, rating plans, reliability indices, quality summaries are issued? At what frequency? Who receives them? Do they need them? Do they understand them? What demonstrable results have these things accomplished? How have they contributed to the profit potential of the enterprise? Usually we will find we have been having Data Fun, i.e. collecting more data than are needed, which has led to Data Frustration because the data are either filed and not used or manipulated when they are no longer serving a useful purpose.

Some people have experienced this dilemma and have swung to the other extreme. They are collecting no data, hence analyzing no data and even refusing to admit that proper data planning, analysis and action has a place in the quality control function.

Let's consider some simple ideas, namely:

1. Don't take a measurement without recording it.
2. Don't record the measurement without a plan for analyzing it.
3. Don't analyze it without some plan to act upon the analysis.

Obviously, these ideas suggest that the relevance

ASQC LCS Codes 730:10;70:000

• • • Data Frustration • • • DATA FAILURE

C. GADZINSKI *Raytheon Manufacturing Co., Waltham, Mass.*

or need for the measurement has been justified, i.e. these measurements are necessary in order to regulate the process of manufacture.

The need for regulating a process is equally obvious.

Although these ideas are simple and obvious, why is it that we have Data Fun, Data Frustration, and Data Failure? Is it because we are so enamoured of the techniques of testing that we don't see why we are testing? Is it because we are so enamoured of the techniques of statistical analysis without seeing why we are analyzing? Or is it because we just don't know what we are doing?

Let's look at some representative examples of our Fun, Frustration, and Failure:

Case I.

Seven men spend full time in preparing a vendor rating. The purchasing agent receiving the rating doesn't understand it, hence he files it and takes no action. Six months after the beginning of the rating routine there is no evidence of quality improvement. It seems we are having Data Fun.

Case II.

A corporation establishes a corporate Quality Control Staff. This staff begins to issue reports on the various operating plants. The plant manager receiving these reports doesn't understand them but is continually bothered by "top side" to "improve" quality. In desperation the plant manager chooses to attend an A. M. A. seminar on Quality Control to learn what these reports are all about.

Here we have Data Frustration both on the part of the recipient of the data and on the part of the person issuing it.

Case III.

In this organization much time and effort is spent on preparing procedures for testing as well as the construction of test equipment. Plans are also provided for the recording of the measurements taken. The scheme breaks down because there has been no provision made for data summary, analysis and action, hence we have a case of Data Failure.

These three cases illustrate the idea of determining the economic points at which to measure in order to control a manufacturing process. The idea, although simple, is difficult to execute and this is largely due to an over-emphasis on techniques rather than management. Management is here being used in the sense of balancing, relating, and equating the subfunctions of the operation into an integral whole.

Capable management would have related the vendor rating plan with objectives of the business and discussed and developed the plan in conjunction with the purchasing agent. Capable management would have discussed with the plant manager in Case II the objectives of the quality control effort and solicited his assistance in setting the quality objectives. Capable management would have seen to it that recorded measurements were analyzed and action taken.

Capable management, knowing the importance of data analysis, could place it in its proper perspective and hence minimize Data Fun. Capable management, knowing the importance of relating data for the purpose of control, would not permit itself to become frustrated because data produced were not being used. Capable management, knowing the value of data, would not collect them without a plan to put them to use.

Capable management is different from capable statistical application, test equipment design, or procedure writing.

Capable management is the effective planning, organizing, integrating, and measuring of physical and human resources to attain a business objective.

This careful planning, organizing, integrating, and measuring of the measurement function called "quality control" will minimize Data Fun, Data Frustration, and Data Failure, thereby reducing costs not only in the area of data manipulation, but in the costs of obtaining data.

The quality control manager can make real savings in his own operation not only in people but in equipment and space.

Effective quality planning, i.e. establishing the economic points in the process of manufacture at which to inspect and test, as well as effective planning of data analysis and feedback can further reduce production costs by assuring quicker response to the need for corrective action.

AUTOMATIC PRODUCTION RECORDING YIELD AND QUALITY CONTROL

JAMES A. CURRY, *Kaiser Steel Corporation*

IN FEBRUARY, 1954, the Operating Management of Kaiser Steel Corporation inaugurated a formalized yield improvement program. A section within the Industrial Engineering Department was established and named the "Quality Control and Yield Group." This group was staffed with Industrial Engineering personnel who had had previous statistical and/or Statistical Quality Control experience.

At the same time a supervisor in the Iron and Steel Division of the Metallurgical Department was assigned to represent the Metallurgical Department in this yield improvement program.

Partially by circumstances, but mostly because it seemed a logical place to start, most of the yield improvement effort for the first year was concentrated in the primary rolling mill.

The Industrial Engineer, the Metallurgist, and the Superintendent organized as a yield committee for the primary mill. Within a very short time certain types of avoidable losses became apparent. Within a year the overall yield in this mill was increased about one percent. These gains were accomplished by a variety of means; some involved methods changes, some involved changes in steel ordering practice, and still others involved closer supervision of operator performance which was aided by charts and reports supplied to operating supervision on a current basis.

Variation—Root of Evil

It soon became apparent, however, that variation, although possibly not the root of all evil, was at least responsible for most, if not all, of the avoidable losses which were being experienced.

To cite an example, an ingot has a nominal weight of 18,700 pounds, from which the primary mill is supposed to get three slabs each 100 inches long, six inches thick and 32 inches wide. These slab sizes have been calculated by Mill Scheduling to give the correct amount of steel from which the Plate Mill is to make a plate of a given dimension and weight within close tolerances. If this slab is too light, then the Plate Mill will be unable to produce the right size plate. On the other hand, if the slab is too heavy, the Plate Mill will have excessive scrap losses from shearing the sides and ends.

To carry the example forward, the steel making unit pours ingots for a plate order. The Plate Mill rolls the slabs produced and 5 percent of them do not make the ordered dimensions and/or weight. Why? There are, of course, innumerable possible reasons, among which the following would be some examples:

1. The primary mill roller might have produced the slabs less than 32″ wide or less than 6″ thick.
2. The primary mill shearman might have sheared some of the slabs too short.
3. The Plate Mill roller might have rolled too thick or too wide; in either case, this would probably result in a short plate.
4. Possibly there was not 18,700 pounds of steel in the ingot to start with because of the variation in pouring in the Open Hearth.
5. Perhaps there was an abnormal amount of "pipe" in the ingot so that the shearman had to cut back the top of the ingot an abnormal amount in order to cut out the unsound steel.

These are only a few of the possible sources of variation which could account for the undesirable end result — the ordered plate was not produced.

On the other hand, ingots or slabs that are too heavy are also highly undesirable. This results in excessive yield loss, too, since good sound steel which should have gone into finished product is returned to the Open Hearth as scrap.

Pattern of Ingot Variation

To isolate these individual causes of variation in an integrated steel plant without interfering with production is an impossible situation unless there are integrated into the production process some check points. This at that time, we did not have.

Starting with a theoretical ingot weight, we went to a theoretical slab weight and then to an actual plate weight and dimension.

How much do ingots vary from nominal weight? It is true that we do have an ingot scale on which we weighed each ingot buggy. Each buggy carried from two to four ingots depending on size of ingot. From this, it might have been possible to determine individual ingot variation from the variation experienced in groups of ingots, but even here we found these results unreliable because we found a bias in the scale weights, which made any estimate of individual variation very unreliable. For instance, if in weighing over this scale the drag was stopped as each successive buggy was centered on the scale, one weight was obtained, but if the scaleman tried to get a "flying weight," then an entirely different weight was obtained, depending on how he operated the scale. Then too we found that the amount and direction of this bias was dependent on how fast the drag was moving over the scales. In fact, subsequent investigation revealed that the theoretical ingot weights were actually more reliable than the scale weights under the conditions which we were weighing.

It was possible to take ingots from various sized molds from the ingot yard and weigh them on a truck scale. From this we were able to make an approximation of the variability of ingots which were nominally the same size. But, considering that each unit weighs

ASQC LCS Codes 730:70:433

from five to fifteen tons, developing enough data to make a reliable estimate represents a real material handling problem, both from the standpoint of the mechanics of getting it done as well as from the economic considerations of cost.

We did, however, develop a program wherein enough ingots of each size were weighed to develop the pattern of variation with a good degree of confidence. We found, generally speaking, that individual ingots varied in weight in the range of ± 5 percent. We were also able to isolate the two major variation sources, the foundry where the molds were made, and the Open Hearth pouring practice. We concluded that about 3 percent of this variation developed because of variation in mold volume and about 2 percent originated in the Open Hearth. These two sources were of course additive which accounted for the 5 percent total.

Determining Slab Variation

As for the slabs which were rolled and cut from these ingots, here was an entirely different source of variation. Rolling slabs from ingots to a predetermined width and thickness had not as yet, at our plant, become an exact science. What were the capabilities as far as both the equipment and the operators were concerned? This too had to be established. Here again we were working with theoretical weights which were developed from ordered dimensions.

The approach of measuring slab length, thickness and width was tried; but, with the exception of length, we came to the decision that measurements as we were able to take them on a production basis, were not a very good index of the amount of steel in the slab. Here again it was apparent that before any real constructive work leading to a reduction in variation in the amount of steel in the slabs could be accomplished, it would be necessary to be able to determine what the variation was and whether it developed primarily from cross section variation or length variation. Weighing of slabs by transporting them to a truck scale, although not as much of a problem from a material handling viewpoint as weighing ingots, was still practically impossible without interfering with routine operating practices.

These then, in brief, are some of the conditions encountered which led us to the conclusion that, in order to realize the potential yield improvement which we knew existed in the primary mill area, it would be necessary to develop some means of obtaining both ingot and slab weights on a day-to-day basis and to use these weights as a method of isolating and fixing responsibility for the excessive variability which we were experiencing.

In 1954 and 1955 contact was made with suppliers of electronic scale equipment and a proposal was developed for the installation of a scale into the primary mill approach table which would weigh ingots prior to reduction into slabs or blooms. A second scale would be integrated into the discharge conveyor table which could weigh the slabs and blooms produced. It was reasoned that, by establishing the incoming weight and by weighing the product produced, not only could the extent of the variability be determined, but we could also develop standard yields which would be a good measure of performance of the mill operation.

Both Management and Operating Supervision were in full accord with the objectives but before approvals for the capital expenditures could be obtained, an expansion program involving the primary mills as well as other areas in the plant began to take form. It soon became apparent that a new primary mill facility was to be included as a part of the plant expansion and as a consequence this first scale proposal was shelved with the understanding that adequate weighing devices would be incorporated as an integral part of the new mill.

Automatic Production Recording

In the course of planning the expansion program, other groups also became involved. These groups reasoned that it was a logical step to proceed from the use of ingot and slab scales which were originally conceived as a tool to be used on a sampling plan basis, to the concept of integrating them into a punched card system which would convert our present accounting system utilizing manual recording of theoretical charge and production figures to automatic recording of actual charge and production figures. This was, of course, far removed from the idea which the yield committee had originally proposed. But, since the whole cost and operation of the system could be justified on the basis of savings in accounting costs, the yield committee for the Primary Mill gave the program enthusiastic support.

As a result, specifications for the Automatic Production Recording system were incorporated as a part of the prime contract for the new mill.

The complete system as designed and furnished by two sub-contractors, one for the weighing devices and one for the recording and punched card equipment, consisting of the following basic units:

1. A typewriter card punch which is located in the Mill Scheduling office. The primary mill rolling order is produced on this equipment as well as a punched card for each ingot on the order. All common information concerning heat, steel type, grade, ingot size, and theoretical weight is prepunched into each ingot card. The primary mill rolling order along with the prepunched cards are delivered to the mill recorder prior to rolling.
2. An electronic ingot weighing scale built into the ingot turnaround which weighs the ingot and transduces the values into impulses accepted by the recording equipment. This scale has a maximum capacity of 80,000 pounds divided into two range increments of 40,000 pounds each.
3. A program or control unit which includes a clock, calculating equipment to determine delay time, and keyboards and punch to insert variable type information into the prepunched ingot cards originally prepared in Mill Scheduling.
4. The slab recording system consists of an electronic scale of 40,000 pounds maximum capacity divided into two ranges; a program or control unit which includes calculating units to accumulate the totals of ingot and slab weight, switches and keyboards to insert variable information; a modified card reader used to read the ingot cards, a modified cardpunch used to punch a card for each slab, duplicating the parent ingot data as well as slab weight, etc.; and finally an

electric typewriter which prepares a written report of all slab activity and periodic totals of ingot and slab weights. This typewriter is tied into the slab recording system.

As designed, this system was developed to give complete accounting information for production, delays, incentive wage payments and, as a by-product, a gold mine of information for the yield committee which would enable us to isolate causes of variation in ingots as well as slabs. In addition, the fact that the information is available immediately, opens up all sorts of possibilities for control of variation. This, we believe, is the whole key to making real yield gains in this area.

All That Glitters Isn't Gold!

I am well aware that it is almost a universal custom in articles of this type to pat yourself on the back, boast of your successes, and generally try to impress everyone concerned by enumerating the tremendous gains which have been made. This is a human trait which is almost universal. We at Kaiser Steel are no different in this respect than anyone else.

But, the fact is that we have very little in the way of success to report on this project. When judged on the basis of its primary purpose — automatic production recording — the system has been a failure in that it has not produced an automatic production record which either the Accounting Department or the Yield Committee (except for closely supervised sampling runs) can accept. In fact, as presently designed, there is considerable doubt that it can ever produce sustained automatically recorded data which will serve the day-by-day requirements of either group or of Operations Management.

On the other hand, under certain limited conditions, it can and does produce information on individual ingot and slab weight variations which is valuable in a yield improvement program.

The reason the system has not been a success from an accounting standpoint is that the system has not yet worked for three successive turns without producing some bad figures. So it is not possible for the Accounting Department to take the totals produced by the system and apply them for accounting purposes. Since it is necessary to maintain a manual parallel production recording system, the Accounting department understandably would rather use its manually generated figures than to reconcile the errors and misses generated by the automatic recording system.

On the other hand, for sampling tests by qualified personnel, where the scale is known to be correctly calibrated both before and after the test, accurate information can be developed on variation of ingot weights, variation of slab weights and yields; and, as a result of this information, we are well along in correcting some of the major sources of variation which was after all a major part of our objective. However, for this purpose alone, we now feel that less sophisticated — and more economical equipment — would have sufficed.

It may be profitable in a situation like this to enumerate the causes of failure and to analyze each one for the purpose of determining what needs to be done to correct it. I suppose this is essentially what the missile people do each time a rocket fails to perform in the expected manner. However, let me add parenthetically that I do not necessarily subscribe to their idea that, even though the missile failed, the experiment was a success.

I think the causes of failure can be divided into two main categories, i.e.,

1. Equipment failures
2. Personnel failures.

Of these two, we feel that equipment failures are much more critical than personnel failures in this case.

Equipment Failures

It is believed by our instrument maintenance department that the electronic load cell is not stable enough in its present state of development to be used as a routine weighing device. This is true not only of the electronic scales in the Automatic Production Recording system, but in other installations of electronic weighing equipment in our mill as well, some of which are located in much more favorable environments than the scales in the Slabbing Mill.

Such variables as ambient temperature, very small line voltage changes, shock loads, moisture, oil, vibration, all of these things, probably affect the read-out obtained from an electronic load cell. Under optimum environment conditions perhaps the load cell may perform well, but anyone familiar with steel mill conditions will appreciate that optimum environment, as concerns the factors listed, is impractical if not impossible to attain.

The only other major difficulty with the equipment was with the card reader. The function of this piece of equipment was to read out both the prepunched information and the variable information on the ingot card and to transmit this information to a card punch, which in turn punched a slab card for each slab produced from the parent ingot.

It perhaps should be explained at this point that the recording and punched card portions of the system were engineered by one division of the Contractor, which at that time operated almost as a separate organization. In engineering this system, they used some of their own components which they had designed and some standard components. The reader was from this division, and it has been admitted, at least unofficially by the parent company, that the reader used was not adequate and should not have been incorporated into the system. The malfunctioning of this reader had the effect of producing mis-punched cards. The magnitude of the errors introduced was so great that it was necessary to manually edit all cards prior to preparation of production and yield reports by Machine Accounting. Even after performing this manual edit, the undetected errors were so large as to make the resultant report unsuitable for accounting use.

In the meantime, there was an internal reorganization within the contracting company which transferred the maintenance of the system over to their Industrial Division. The reader was replaced by a modified standard reader. Since this change, the reader has practically ceased to be a problem.

Personnel Problems

In the introduction of this system, as with all departures from established routine, we anticipated that there would be many problems concerning the personnel involved. Operating personnel have to push switches to activate the system; Shearman have to activate the weighing mechanism for slabs in addition to their regular duties; the Mill Recorder had to acquire an entirely new set of skills; the

Order Writers in Mill Scheduling had to learn to use electric typewriters and operate a card punch where before, rolling orders were hand written. However, we were very pleased to find out that these problems turned out to be of less magnitude than we had expected. Our major trouble in this area has been in obtaining proper maintenance of the scales and mechanical transducing equipment.

It is undoubtedly true that the training of good electronic scale repair and maintenance men takes considerable time and since maintenance of this equipment is very different from instrument repair work regularly found in a steel mill, this fact has produced for us a real problem.

Another problem, and one which has not yet been satisfactorily resolved, is the problem of zeroing in the scales. This problem develops of course in the inherent instability of the electronic load cell. In order to maintain calibration, it is necessary to put a test weight on the scale — 25,000 pounds for the ingot scale and 4,000 pounds for the slab scale. So as not to interfere with mill production, this has to be done during a mill delay.

Since in most cases mill delays cannot be anticipated in advance, the instrument maintenance personnel are usually not readily available, and before they can be located and brought to the mill, the delay is over. On the other hand, to keep a maintenance man on standby to wait for a delay is an uneconomical practice also. However, if greater stability could be engineered into the weighing mechanism, this problem would largely disappear.

I would like to re-emphasize the fact, though, that the failures in both equipment and personnel are much more critical from the standpoint of accounting applications than they are from the point of view of their use to accumulate basic variability and performance data on a statistical sampling basis which is, after all, the original purpose which the quality control and yield committee had in mind. The reason for this is that accounting requirements for inventory, incentive pay, and cost analysis, require continuing accurate information, whereas statistical analysis requirements can be met with sample data obtained during intermittent, closely controlled periods.

Future Plans

What of the future as regards the application of this type of equipment to the steel industry? As far as we at Kaiser Steel are concerned, it is a somewhat muddied situation. We are now of the opinion that the system we have has serious shortcomings. The muddiness in the situation resolves itself around the question as to whether it has the capabilities of ever performing satisfactorily for accounting purposes. If not, then it is much too elaborate, and incidentally too costly a system to obtain information for yield and quality control purposes alone. It is somewhat like buying a fine precision jeweled watch to do a job for which a $3.00 alarm clock is better suited.

On the other hand, the Primary Mill Operating Management and Supervision have had a taste of what this type of installation can really do from the standpoint of yield and quality improvement, and are insistent that all ideas of discontinuance of the present system be considered only on the basis of replacement by some better and more economical means of obtaining essentially the same basic information.

The operating personnel have found this system to be very beneficial in maintaining the identity of the material through the rolling, shearing, and marking operations. Another benefit, and this may be the one most lucrative, is the use of the slab weights obtained as a process control device. During periods when the scale is known to be supplying accurate slab weights, it has been possible to detect changes or drifts in the rolling or shearing operations. Whenever the slabs are not cutting out as scheduled, an examination of the ingot and slab weights permits an immediate determination of whether this is due to insufficient ingot weight or due to rolling or shearing practices. Incorrect rolling or shearing practices can then be corrected immediately, thereby reducing yield losses.

What happens in this area in both the immediate future and the long range depends primarily upon resolution of the problem of insuring that a weighing device will consistently provide accurate weights of ingots and slabs under the conditions which prevail in the Slabbing Mill.

Need for Accurate Weight

The ability to utilize reliable impulses from a weighing device to automatically enter the actual weights into data recording and processing equipment presents a relatively minor problem according to our systems personnel. But, as I have indicated previously, without accurate weights initially, no amount of subsequent sophisticated mechanized or electronic data processing will make the information usable where day-by-day reliability is necessary.

There is little disagreement with the desirability of automating and mechanizing the recording processing of production data when it can be done accurately and economically. The problem is to keep objectives and systems in step with the "state of the art." It appears that our present system may have been developed ahead of the "state of the art."

Our maintenance and repair people feel that from a practical day-by-day operating viewpoint, the electronic load cell is an impractical device in the environment in which it is generally used in a steel mill. If this is true, and our experience would seem to lend credance to this idea, then regardless of any computer and recording limitations, the system is unacceptable for production recording.

At present, investigation is being carried forward as follows:

1. The Engineering Department is carrying forward studies to determine the feasibility of substituting either mechanical scales or hydraulic scales for the existing electronic scale components.
2. In conjunction, the Data Systems Department is investigating the possibilities of a much less complex system which would give at least most of the basic information which we are now getting.

In conclusion then, it appears that the direction we will take in this program would possibly be to search out more reliable weighing methods, to devise a less sophisticated, but at least semi-automatic recording system — one which would adequately satisfy the requirements of both operating management and yield and quality control activities — and possibly, in the near future, depending on advances in data processing equipment reliability, again move toward the ultimate goal of automatic production recording.

Applications of Industrial Statistics In Research and Development

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Introduction

There's a lot more activity in applying industrial statistics in research and development now than there was even a few years ago. Reaction from the outside is pretty much the same, however. Someone has it all figured out that if you laid all the quality control people in the United States end to end, they'd point in all directions.

Organizing to Apply Statistics

In the Carborundum Co., supervision tries to keep them pointed in the right direction. It might be interesting to describe something about what the company is doing. It begins with organization. The company has decentralized operation with centralized control. There are process quality control groups in each plant responsible to manufacturing supervision. There are staff quality control groups at divisional level and a central quality control staff at corporate level.

We are concerned, in considering R & D applications, primarily with the staff quality control groups. In the operating divisions the Technical Branches are organized in three departments: Quality Control, Development, and Engineering. Thus, all technology is brought under the same supervision and Quality Control becomes the moderator of them all, giving assistance laterally to Development and Engineering as well as to the vertical line.

At the corporate level, all technology is administered by the Director of Research and Development. At this level Quality Control is one among seven branches: Basic Research, Engineering Research, New Product Development, Laboratory Services, Engineering, and Patents, being the other six. At this level, too, assistance is given laterally to Research, Development, and Engineering Branches, and vertically to the divisional QC staffs.

The central Quality Control Branch is organized in three departments (it is when we get into the activities of these departments that we can begin discussing cases):

1. Process control, which assists in devising and installing process control procedures, including plant-scale experimentation. This group also provides liaison between plant engineer or laboratory scientist and our Data Processing Branch of the Comptroller's Division which controls the company's Univacs.
2. Quality Assessment, which conducts independent QA tests on random samples of product. It also continuously reviews specifications, and controls their distribution to subsidiaries.
3. Operations Research, which does usual OR tasks, such as inventory control or design of decision, and designs of experiments.

There is also a Quality Control Laboratory in which the quality assessment tests are done. This lab is responsible for standardization and calibration of equipment, does work on precision of methods and development of new measurement techniques, and is experimenting with a data sampler and digitizer.

The company staff QC group coordinates a number of joint projects, such as study of the effects of modifications of abrasive grain on various types of products and development of friability test for abrasives. It also leads in problems of world-wide quality comparison, standardization and interchangeability.

A Program for Application of Statistics

That's a quick summary of the organization. To make it go, there has to be a program; the organization has to be motivated. With the central Quality Control branch located where it is, it is highly motivated to spend most of its time on "Applications of Industrial Statistics in Research and Development." Most of the available techniques have been applied, according to the requirements of the problem — so there is little tendency to "ride" any particular technique. All problems are not solved by multiple regression, nor by highly fractionated factorial experiments, nor response surface techniques, nor by EVOP. As a matter of fact, Quality Control is quite critical of the use of a more complex technique than required by the problem. Similarly, in use of high-speed computation, the Branch has to be convinced that the

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Presented at the Annual Quality Control Clinic sponsored by the Rochester ASQC section, April, 1960.

analysis couldn't be done satisfactorily on a desk calculator. There is no hesitation about the use of a technique because of its complexity once enough is known about it to make its properties appreciated. (Some techniques have been presented in the literature in ways which are not very convincing). On the other hand, the use of ranges techniques and other lowly methods is not avoided when they are apt to be productive.

This, as may have been suspected, leads up to a discussion of the philosophy and method of operation of the industrial statistician in a research situation rather than to a description of the techniques. After all, most people who are interested in research and development applications are already very adept in statistical technology or can turn for help to those in their organization who are.

Using Background Data

The first thing we are concerned with is a look at the background data. Disappointments are often suffered when care has not been taken to learn from the engineer or scientist the *technical* significance of the variables in an experiment. For example, in correlating chemical impurities in zirconium metal with Brinell hardness, it was found too late by sitting down with the plant engineers, that the data had been taken from different sampling points. We might follow literally the recommendation that we read the experimenter's notebooks. We shouldn't run into this problem if the data analysis were done by the experimenter himself.

We can start by giving the data the "eye-ball" test. That is, we can simply look it over carefully for defects *before* we spend valuable time analyzing it formally. This involves experience and skill which may be considered a counterpart of the engineer's or scientist's skill and knowledge of theoretical backgrounds. There are a number of rapid techniques which could be applied.

One approach that suggests itself is to make scatter plots of the data to detect any close association among pairs of variables. (Plot one variable on the x-axis against the paired value of the other variable on the y-axis.) In the correlation of impurities against Brinell hardness, scatter plots were drawn which were at variance with the information on known relationships that had been provided by the engineers. This should have been recognized as a clue. The statisticians shared blame with the engineers who should have been a little more critical of their data too. The statisticians' sin, incidentally, was one of omission; the engineers', one of commission. The statisticians simply overlooked the error, the engineers committed it because they had actually varied from specification by picking up part of the samples from a different processing stage where they were in a form which could be analyzed more easily.

To continue, however, the rapidly made scatter plot on which a line of best fit may be drawn by eye may lead, if it turns up apparently strong relationships, to simple correlations or a multiple correlation of all variables. One of the present day temptations, with high-speed computers available to turn out results in minutes, is to go right ahead and take one step after another. Experience cautions that we should pause and reflect between steps, even if we can get all the steps at once within cost limitations.

We may be justified, at times, in using another "eye-ball" technique, frequency distribution plots. We may simply want verification that the data are somewhere near normal. Or, we may actually get valuable guidance if the distribution is bimodal (mixed data), or rectangular (chaotic data), or skewed. In the latter instance, we might ponder the suggestion that machine and instrumental errors tend to be normal, human errors log-normal or that we have a situation in which a large number of small sources of error are present and they are multiplicative rather than additive.

Those familiar with statistical quality control techniques will know how to use control charts for analysis of data (as contrasted to their use for control). American Standards Association Standard Z-1 deals with this application of control charts. For example, range charts may be used to study homogeneity within sets of experimental data, or time trends in data may be detected using an average chart.

Table I — Results of Data Analysis

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	Components of Variance
Containers	SS_c	2	MS_c	$\sigma_e^2 + 2\sigma_s^2 + 6\sigma_c^2$
Samples	SS_s	6	MS_s	$\sigma_e^2 + 2\sigma_s^2$
Tests (Error)	SS_e	9	MS_e	σ_e^2
Totals	SS_T	17		

Preliminary Scanning of Data by High-Speed Computer

So much for what might be done in scanning background data without aid of a high-speed computer. If a computer is available, it may be worth while to subject the data to preliminary scanning before using it in a refined analysis or using it as a basis for designing further experimentation. ASTM Committee E-11 is interested in the problem of what should be included in a program for a preliminary scanning of data. We know that some computer users like Bell Laboratories have given a lot of thought to this. Carborundum has a general analysis program for Univac I which can give a quick run down on masses of data as follows:

1—Average, variance, and standard deviation of the data

2—Mean squared successive difference

3—Number of runs above or below the average

4—Averages and ranges of subgroups

5—Regression of items versus chronological order

Choosing the Method of Analysis

By this time, we are deeply involved in the next major step in applying statistics to our research problems. That is the step of choosing the method of analysis. The way we analyze the data may depend on the way we have collected the data or the way the experiment is designed. For example, the analysis of variance which may apply to data from a designed experiment may not be applicable to data obtained unsystematically. The range of techniques available may depend on the individual's computational skill (sometimes it appears to depend on ability to read a 'cookbook'). Or, it may depend on available computer programs. A library of varied programs is an asset to anyone engaged in applying statistics in research and development. At present, the library available at

Carborundum may be outlined as follows (in addition to the General Analysis program already described):

Program No.	Name	What Program Calculates
1	Moving Range and Moving Average	Moving average and range (n=2) grand $\overline{\overline{X}}$, $\overline{R}$; Control limits for $\overline{X}$, R, σ
2	Simple Regression	Slope; Intercept; average y and x; $\overline{y} - b\overline{x}$; standard error of b.
3	Multiple Regression (Limitation: 20 variables including dependent. No more than 2000 observations of each variable)	Slopes for multiple regression, either linear or curvilinear; Residual mean squares; F-test for reduction in sum of squares; moment matrix, variance-covariance matrix, multiple correlation coefficients
4	Matrix-Math Compiler	Matrix Algebra (addition, multiplication, inversion, etc.). In Regression: coefficients, test of significance (t-test), observed-calculated, multiple correlation coefficients
5	Factorial ANOVA (6-way)	Computes the standard analysis of variance table, the sum of squares, degrees of freedom, mean squares, error term and F-ratios
6	Analysis of Variance (complete nesting)	To analyze up to ten groupings, with n replications per grouping
7	Analysis of Variance	To analyze a mixed model with five variables, two of which are crossed and have only six and three levels respectively. The remaining three variables can have N levels. There can be n replications.
8	Plotting	Contours for two or three variables
9	Canonical Analysis	Calculates eigenvalues and eigenvectors for a real symmetrical matrix
10	Hotelling's T^2	To calculate Hotelling's T^2 and also averages and variances to be used for individual t-tests if T^2 is not significant.
11	Simultaneous Confidence Interval	Calculates confidence interval of two coefficients

Others are in various stages of readiness, including a program for plotting control charts.

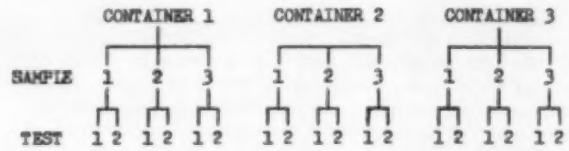
Designing the Experiments

Inevitably in the course of applying statistics to R & D, we reach the stage of designing experiments. If the subject of this article could be treated in two words, they would be, "Design experiments!" In designing experiments we may have various ends in view: testing the significance of factors (screening for the most important); determining the size of effects (estimating average responses); measuring the components of variation; or describing the relationships among variables by empirical equations (or plotting the responses). No one type of design is superior to the others, because different types can serve the different purposes. For example, highly fractionated factorials may be used for screening and response surface experiments may be used to determine the equations for the relationships. As a matter of fact, one may plan to use first and then the other in sequence.

Whatever type of design is to be used, it is necessary to understand the problem in terms of the physical factors and then describe it in terms of a mathematical model.

In the study of the precision of testing, for example, attention needs to be paid to the preliminary sampling and handling of the samples. It may seem superfluous to emphasize the importance of these preliminary steps, but as a matter of fact, it can hardly be over done, especially in sampling of chemicals or other bulk materials for testing. Preparation of a flow sheet will help firm up the picture of how the material moves through the sampling and testing procedures. This graphical representation of the physical situation can lead directly to the mathematical model of the experiment.

For example, if we expect to take a number of samples from each of several containers, and perform duplicate tests on each sample, we can portray the procedure in the following diagram:



Then, the mathematical model may be written, as follows:

$$X_{ijs} = \mu + C_i + S_{j(i)} + e_{s(ij)}$$

The mathematical model leads to the correct method of data analysis, the results of which may, in an experiment of this sort, be expressed in a variance table, such as Table I.

In this experiment, we have chosen, presumably, three containers at random, have taken three samples from each at random, and have made two random tests on each sample. Since we know this and know the mathematical model, we know how to determine the components of variance. Knowing the components of variance we can make the proper statistical tests of significance. It will be well to note that the hypothesis for testing non-random factors are of a different nature than those for random factors.

This is a very simple example and in many types of experiment we may not be concerned primarily with significance testing. Nevertheless, the desirability always exists of understanding the underlying physical model, preparing a flow sheet or diagram, writing out the mathematical model, and thinking through the statistical techniques that will be applied.

Conclusion

We have considered several steps in the use of industrial statistics in research and development:

1—Studying the background data
2—Selecting the method of analysis
3—Designing the experiment

There is, perhaps, another step. This step is exemplified by a kind of instrument that is being applied here and there in industry. This instrument takes several channels of data transduced from a process under investigation in the plant or from an experiment in the laboratory. It samples the data at stated intervals. It indicates and records this information in batteries of meters on a panel. It converts this information from analog to digital form and punches it out on a paper tape. It checks the information on the tape against input from the experiment.

The tape is then used in a high-speed computer programmed to analyze the experiment and print out in several planes the families of curves which describe the relationships of the experimental factors.

Thus, without the intervention of error prone humans, it takes data directly from the experiment and prints the final report. This is the step in applying statistics in research and development which may eventually do away with industrial statisticians!

Intercomparison of Laboratory Test Methods

Summary Technical Report, August, 1960

National Bureau of Standards, Washington, D.C.

Summary

The National Bureau of Standards has developed a mathematical model for statistical analysis of factors involved in variability of inter laboratory test results. The method is used to distinguish between random and systematic laboratory differences that cannot be represented by constant biases. Although designed primarily for the study of a single test method or an inter laboratory scale, it can be used for inter laboratory comparison of two alternative test methods.

Introduction

A method for evaluating mathematically the factors involved in the variability of inter laboratory test results has been developed by J. Mandel and T. W. Lashof of the National Bureau of Standards.[1,2] This "model" for statistical analysis has been successfully applied to several problems involving both physical and chemical properties of materials. A better appraisal of test methods can be made by utilizing the method to distinguish between random and systematic sources of error.

While the model is designed primarily for the study of a single test method on an inter laboratory scale, it can also be used for the interlaboratory comparison of two alternative test methods. For this purpose, it is applied in conjunction with another statistical procedure, the sensitivity criterion,* involving the functional relation between the results obtained by use of the two alternative test methods.[3]

The true reproducibility and therefore the usefulness of a method of measurement are unknown until the method has been evaluated on an inter laboratory scale. However, the interpretation of data from inter-laboratory round robins is not always straightforward. There has been need for a clearly formulated model that would relate mathematically the various factors entering into the measurements. In recent years, considerable attention has been given to studies of test methods involving relatively large numbers of laboratories. These studies resulted from the observation that even when well-established methods of measurement are used, the agreement among laboratories is, in general, much less satisfactory than the agreement which can be achieved within a single laboratory.

The sources of variability usually considered in such studies include:

(1) Replication error, or differences among results obtained at one laboratory by one operator using the same instrument on specimens of the same material;

(2) laboratory main effect, or systematic constant differences among results obtained at different laboratories; and

(3) laboratory-material interaction, or variations among laboratories in the differences among results obtained for various materials.

The present method separates the third source of variability into two components; one is random, and the other reflects systematic laboratory differences that cannot be represented by constant biases. To account for the random scatter one must consider, in addition to replication error, the effects, upon the measured value, of properties other than that property being measured. The interfering effect of such properties often varies among laboratories, causing additional scatter in the inter laboratory results. Another source of random scatter is improper calibration of equipment. In certain instruments having multiple scales, part of the random scatter has been shown to arise from lack of continuity among the scales or from variation in the ratios among the scales.

In the absence of systematic errors, a graph of the results from one laboratory plotted against those from another shows a scatter of data points about a straight line bisecting the angle formed by the axes (a line of 45° slope). If the results from one laboratory were consistently higher or lower by a constant amount than those from the other, the line would be higher or lower but would be parallel to the first line; that is, it would lie at 45° to either axis but would not pass through the origin.

In practice, the lines obtained are not of 45° slope, and it is this nonparallelism or slope effect that reflects a varying systematic difference between the two laboratories. For example, an error in the determination of the normality of a reagent will cause a proportional type of error in all analyses employing this reagent. For any number of laboratories, the slope effect can be generalized by plotting the results from each laboratory against the average of the results from all.

The separation of various error sources provided by this method permits evaluation of possible benefits derivable from reference samples. In the case of constant differences among laboratories, a single reference sample is sufficient. If the slopes of the lines plotted for various laboratories differ to a great extent, the use of two reference samples is indicated. Suppose that specimens of two reference materials are supplied to all participating laboratories. The two materials, al-

ASQC LCS Code 500:70:000

*The sensitivity of a method A used in the study of a property Q is defined as $(\Delta A/\Delta Q)/\sigma_A$, where A is the measurement obtained and σ_A is the standard deviation of method A.

Three Engineers Receive Awards

The following awards were made Jan. 10 at the Seventh National Symposium on Quality Control and Reliability at the Bellevue-Stratford Hotel, Philadelphia, Pa.

The *1960 National Reliability Award* was presented by W. T. Sumerlin, general chairman of the Symposium, to ROBERT E. MOE for the best paper presented at the Sixth National Symposium in 1960.

Mr. Moe is manager of engineering, Receiving Tubes Department, Electronic Components Division, General Electric Co., Owensboro, Ky. He was graduated from the University of Wisconsin with a B.S. degree in electrical engineering.

In 1947 he was awarded the U.S. Navy Certificate of Commendation for contributions to radar indicator design. In 1958 he was appointed as an Industry Consultant to the Department of Defense *ad hoc* Study Group for Parts Specifications Management for Reliability.

In 1960 he was elected to the Board of Directors of the Institute of Radio Engineers. He is a member of ASQC, the Kentucky Society of Professional Engineers, the National Society of Professional Engineers, Eta Kappa Nu and Tau Beta Pi, and is registered as a professional engineer in the states of New York and Kentucky.

The *1960-61 ASQC Electronics Division Award* was presented by Gordon H. Beckhart, division chairman, ASQC, to Dr. LESLIE W. BALL for his outstanding contributions in the field of reliability and quality control.

Dr. Ball is director of reliability for the Aero Space Division of Boeing Airplane Co. He was born in Canada and attended Buxton College in England and also the University of Manchester. He continued in physics research at the Canadian National Research Laboratories until coming to the U.S. as associate technical director of Triplett and Barton. He was chief of the Mechanical Evaluation Laboratories and chief of the Physics Research Department at the Naval Ordnance Laboratory. He was also head of the Underwater Ordnance Research Program at the Naval Ordnance Test Station.

He was engaged in full time reliability consulting work with the defense agencies and a dozen major aerospace companies. His publications include about fifty papers in the field of physics research, X-ray, ultrasonic and dynamic testing and both the technical and management aspects of reliability.

1960 National Symposium Award presented by W. T. Sumerlin to ROBERT G. FITZGIBBONS for the best moderated session at the Sixth National Symposium in 1960.

Mr. Fitzgibbons is reliability and quality control engineer with Raytheon Co., Government Equipment Division, Wayland, Mass. In this capacity, his efforts are devoted to co-ordinating division reliability and qc activities and fostering improved reliability and qc methods. He was formerly with the Bendix Aviation Corp. where he was in charge of reliability on the Talos missile. Mr. Fitzgibbons is a graduate of Washington University with a B.S. degree in Industrial Engineering, and has also studied at Johns Hopkins University and the University of Notre Dame.

The high caliber of the recipients of these special awards is indicative of the importance with which Reliability and Quality Control are now regarded by both the Military and Industry.

Automotive Division Conference Feb. 11

The Fourth Annual Automotive Division Conference will be held Saturday, Feb. 11, at Rackham Memorial Bldg., 100 Farnsworth Ave., Detroit, Mich.

It will be co-sponsored by the ASQC Automotive Division and the Greater Detroit section.

The conference has been designed to furnish comprehensive coverage of the latest techniques and managerial practices that are being developed to meet the growing demands for improved product reliability.

The program will include *Introduction to Reliability*—effectiveness of a firm's reliability activity as affected by responsibility and authority assignments within the organizational structure; *Case Studies in Reliability*—evaluating product reliability, a firm's reliability relations with its suppliers and with its customers, and *Reliability Techniques*—failure reporting, reliability studies using Weibull probability paper, and plotting experimental data on normal or log-normal probability paper.

For additional information, contact John Birecki, publicity chairman, Chrysler Corp., Mound Road Engine Plant, P. O. Box 258, Detroit 31, Mich.

though necessarily similar in nature, must differ considerably in the value of the property under test. The values for this property obtained by measurement in any given laboratory for these two materials can be compared with the known correct (or assigned) values; then at each laboratory the measured values for any submitted unknown sample of such material can be "adjusted" and brought into line with the similarly adjusted values from other laboratories.

The use of reference samples to improve interlaboratory precision is an accepted procedure and differs little from some calibration methods; however, reference samples should be used for this purpose only after all economically feasible improvements in the control of environmental conditions or other desirable modifications of the test procedure have been exhausted.

Most statistical methods are highly sensitive to extremely discrepant values. The present method contains several safeguards against misleading results due to the inclusion of outlying measurements. Standard deviation of replication error is examined for each material and laboratory. Single discrepant values are then easily detected from inflation of the corresponding standard deviations. Trends are handled statistically through appropriate transformations of scale. If all the replicates obtained by one laboratory for a particular material are affected by the same error, the contribution of this laboratory to the random part of the laboratory-material interaction will be unduly large and consequently obvious. A laboratory discrepant in all values will be apparent from the fact that its line will differ from the others appreciably in position or slope.

Sometimes these discrepancies can be clarified and the nonconforming values replaced by the results of measurements taken under proper conditions. When no reason for the conflict can be found, the values must be considered as possibilities in the application of the test method.

(1) "The Measuring Process," by John Mandel, *Technometrics 1*, 251 (1959)

(2) "The Interlaboratory Evaluation of Testing Methods," by John Mandel and T. W. Lashof, *ASTM Bul. 239*, 53 (1959)

(3) The Sensitivity of a Method A Used in the Study of a Property Q is Defined as $(\Delta A/\Delta Q)/\sigma_A$, where A is the measurement obtained and σ_A is the standard deviation of method A

(4) Evaluation of test methods by the sensitivity criterion, NBS Tech. News Bul. 40, 139 (1956)

PAUL A. ROBERT, *Editor* *Precision Products Co. of Cincinnati, Box 130, Norwood 12, Ohio*

Geometric and Positional Tolerancing

PART III

ANNE L. FONTAINE, *American Radiator & Standard Sanitary Corporation, Plumbing & Heating Division—Plumbing Fittings Section, Cincinnati Research & Development — Cincinnati, Ohio*

Coordinate Tolerancing

The most commonly used method of locating holes, bosses, slots, tabs, etc., has been the coordinate dimensioning system, either rectangular or polar. One of the drawbacks in this system is that each coordinate dimension usually carries its own individual tolerance, even when located from a datum, and the tolerances accumulate. There is more accumulation if the datum is tolerated. (Fig. 18). Note that the toleranced coordinates produce a square tolerance zone. The location point of the feature could fall along a 45° angle within the square, and the stated tolerance would be exceeded. Polar coordinates would produce an angular tolerance zone as shown in Fig. 19.

Coordinate tolerancing may be a satisfactory system when it is not necessary for the features on one part to mate precisely with corresponding features on another part. There is, however, the possibility that inspection would reject the parts, even if they are within tolerance, because of uncertainty as to their mateability or interchangeability. One solution to this problem is a method that has been used by the aircraft and automotive industries for some years, and which is mandatory on armed services contract drawings. It is called True Positional dimensioning and tolerancing.

True Position

True position (TP) is a theoretically exact location, expressed by the symbol ⊕

True position tolerance states how far the actual position may

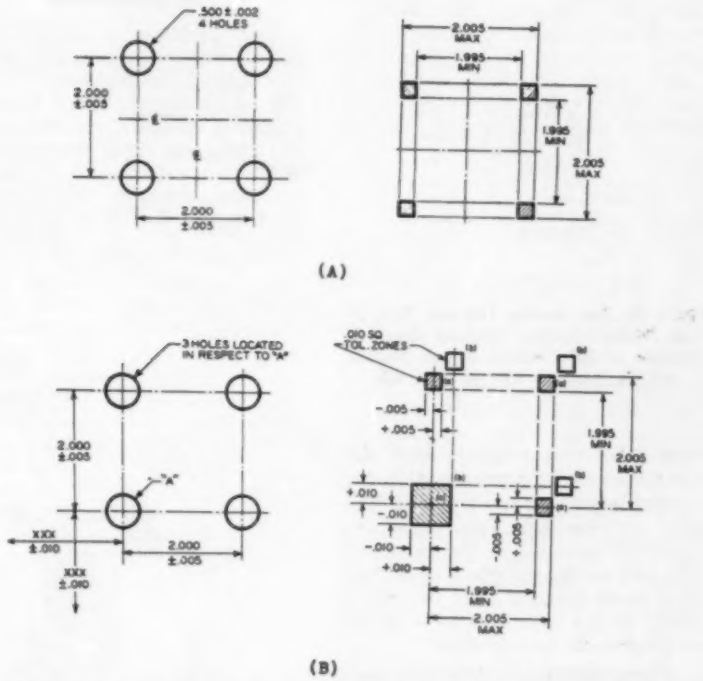


Figure 18—Square Tolerance Zones Produced by Coordinate Dimensions (A) Without Reference to a Datum, and (B) Reference to a Datum

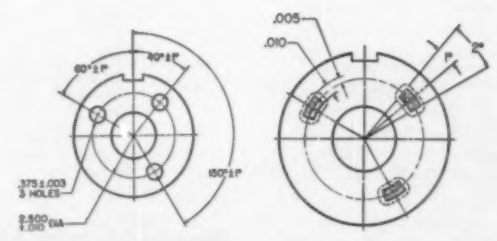


Figure 19—Angular Tolerance Zone Produced by Polar Coordinates

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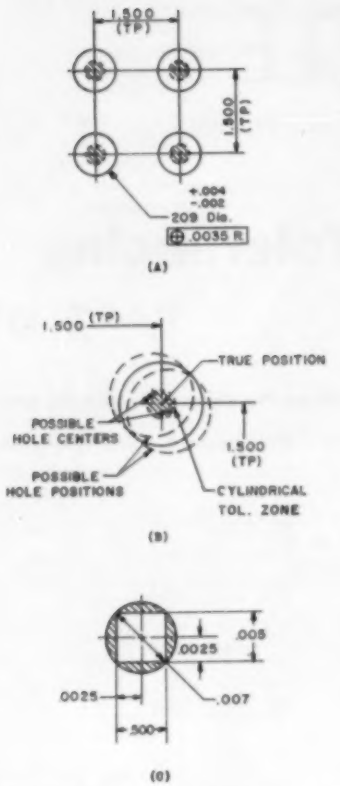


Figure 20—True Position Tolerance Zone, (A) True Position Circular Tolerance Zone, (B) Locations of Hole Centers in True Position, and (C), Tolerance Zone for Each Hole

vary from true position. It is the allowance of drift permissable for drilled holes and milled slots. The true position tolerance zone defines the area on or within which the axis or center plane of a feature must lie, the axis or center plane of the tolerance zone being, of course, at true position.

When locating cylindrical features, holes, bosses, etc., by the true position system, the tolerance is specified as either a diameter or a radius. (Fig. 20A). This method produces a circular tolerance zone. The axes of the holes may lie anywhere on or within these circles, and at any point the possible locations will be equally distant from their true position. An advantage to be gained is illustrated in Fig. 20B. The entire area outside of the square coordinate tolerance zone may be used, yet interchangeability will be maintained. Not only is a greater tolerance area provided, but the use of tight tolerances, necessary in coordinate dimensioning to insure precise location, is eliminated.

The tolerance zone for the true position of non-cylindrical features, such as slots, keys, tabs, etc., is expressed as a WIDE ZONE. (Fig. 21). The sides of the zone are parallel at all points to the true position axis. The total width of the zone is equal to the true position tolerance.

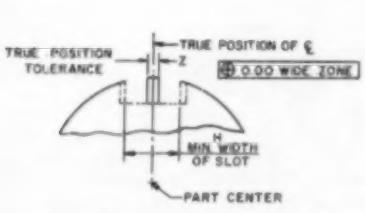


Figure 21—True Position of a Slot

Datum Features

True position is always established with reference to a datum. The basic true position of a feature is located from the datum by means of untoleranced dimensions. All dimensions that locate true position are assumed to be perfect, or true, and are designated on drawings as BASIC or BSC. There is no accumulation of tolerances, and no guesswork in interpreting the tolerances.

The datum may be inferred, as illustrated in Fig. 22A, when the features are to be held relative to each other. The inferred datum planes A & B in Fig. 22B are assumed to be perpendicular to each other at 90° ± 0°. However, when mating parts have matching feature patterns, and alignment of the parts depends upon another feature, such as a bore, pilot hole, or surface, then this feature must be specified as a datum. (Fig. 23). The datum may require a geometric tolerance of roundness, flatness, etc., to assure correct inspection of the features' true position.

True Position Control of Other Geometric Characteristics

Since the true position tolerance zone is a cylinder when applied to the axis of a hole, the tolerance also controls concentricity of the hole and perpendicularity of the hole with respect to surfaces. (Fig. 24A). The axis of the hole at all sections along its length must fall

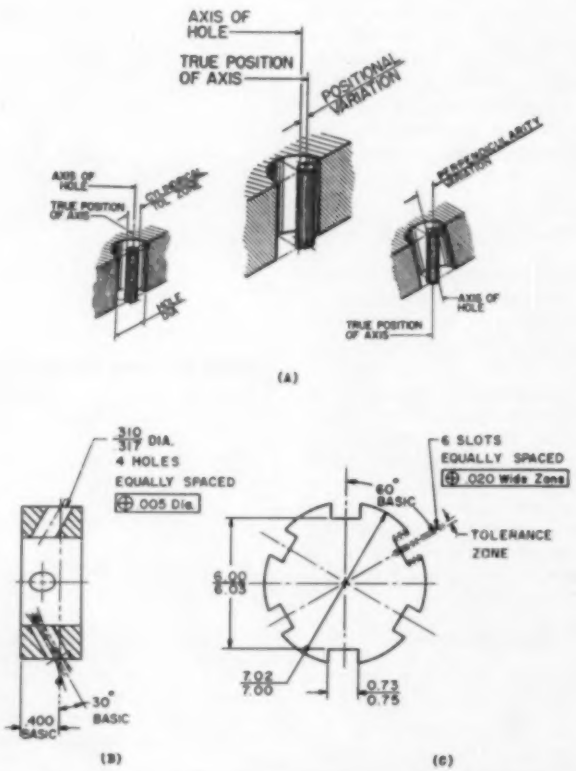
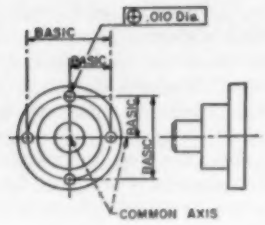
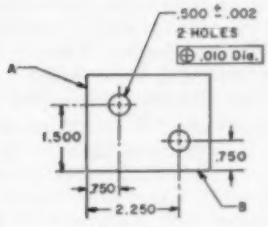


Figure 24—True Position Control of Geometric Characteristics, (A) Perpendicularity Control, (B) Angular, Axial and Linear Control, and (C), Angular Location



(A)



(B)

Figure 22—Datum Features, (A) Inferred Datum Features, and (B), Inferred Datum Planes

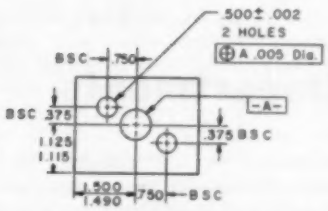


Figure 23—True Position Referred to a Datum Feature

within the tolerance cylinder, whose axis is located at true position. The variation in perpendicularity is also limited by this rule.

Fig. 24B illustrates the angular, axial and linear control that true position tolerances exercise over non-parallel holes.

The angular location of keyways controlled by true position is illustrated in Fig. 24C. In this case the tolerance zone is rectangular.

Modifiers

In the list of symbols given in Part I were Ⓜ Maximum Material Condition (MMC) and Ⓢ Regardless of Feature Size (RFS). These modifiers are particularly applicable to true position toleranacing as the limits of location are determined by the actual finished size of the location.

Maximum Material Condition (MMC)

When a feature of a finished product contains the maximum amount of material permitted by toleranced size dimensions, it is at MMC. Internal features, such as holes and slots, contain their maximum material at their minimum tolerance size. External features, such as tabs, shafts, bosses and thicknesses, contain their maximum material at their maximum tolerance size. When parts are to mate or be interchangeable the true position tolerance is usually specified for the parts at their maximum material condition, since the mating parts are then at their least favorable relationship.

As we know, size tolerances are applied to allow realistic variations from a perfect form. These variations must be considered when true position at MMC is specified. As features move from maximum material tolerance toward minimum material tolerance the distance between feature centers increases, and may exceed the positional tolerance specified. This increase can be used to advantage, provided true position at MMC is stated on the drawing. (Fig. 25). The increased locating tolerance

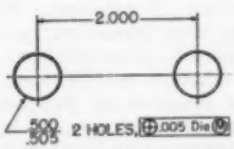


Figure 25—True Position Stated at MMC

will permit inspection to accept parts that will assemble and function properly which otherwise may have been rejected as being out of positional tolerance. Fig. 26 illustrates the additional positional tolerance provided when a feature departs from MMC. It is calculated as the difference between the specified minimum size and the actual size of the hole. It might happen, in actual practice, that a hole would be drilled to its minimum diameter, in which case the actual

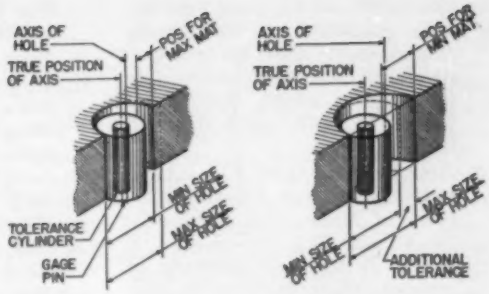


Figure 26—Additional Tolerance Provided by MMC

location of the hole must be within the positional tolerance shown on the drawing.

Regardless of Feature Size

Maximum material condition does not apply in all instances of true positioning. In many cases, location of features is more critical, and the limits of location must be held regardless of the finished

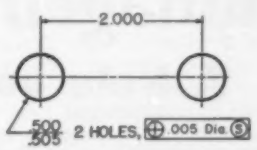


Figure 27—True Position Stated RFS

size of the feature. Fig. 27 shows the method of indicating this condition on drawings. The true position tolerance must then be observed regardless of feature size.

If neither MMC or RFS are to be specified on the drawing, then it is the responsibility of the draftsman to tolerance the features in such a way as to compensate for the conditions.

Annotated Bibliography

Because of the varied interests of persons working in the field of form dimensioning and toleranacing, we offer the following annotations of readily available sources for further investigation.

1. American Machine and Foundry Company Standards, *Tolerance Delineation.* Tolerances and surface finishes for the common geometric conditions.
2. *American Machinist Reference Book Sheets,* June, July, August, September, October, November, 1958; Walter E. Harrington, Avco Research & Advanced Development Division, Avco Mfg. Corp., Lawrence, Mass.; McGraw-Hill Publishing

Co., 330 W. 42 St., New York 36, N.Y. Contains a conversion (comparison) chart for true-position dimensions and coordinate dimensions which should be useful to both machinist and inspector.

3. *American Standard Y14 5-1957*, published by the American Society of Mechanical Engineers, 29 W. 39 St., New York 18, N. Y. A detailed example of various interpretations in gaging two holes specified on a drawing is given on pages 37 and 38.
4. Bibeau, D. and Sweet, D., *True Position Dimensioning*, 1959, Scintilla Division, Bendix Aviation Corp., Sidney, N.Y. True position explained by color illustrations. A training film on True Position is also available from Scintilla. When requesting the film, specify both a preferred and an alternate date.
5. Blye, H., "Geometric Tolerances," Bellerose, Long Island, N.Y., *Machine Design*, September, 1955. Presents machining tolerance charts for the most commonly specified geometric conditions.
6. *Military Standard MIL-STD-8B*, Nov. 16, 1959, United States Government Printing Office, Washington 25, D.C. This latest revision incorporates the ASA Y14.5-1957 Geometric and True Position dimensioning and tolerancing specifications. In addition, there are several examples of highly complicated parts dimensioned and toleranced according to this specification.
7. Spalding, Fred L., Associate Professor, Engineering Dept., University of Illinois, Urbana, Ill. "Tolerances of Form," *Machine Design*, May 15, 1958; "Symbols for Geometric Tolerances," *Machine Design*, Oct. 15, 1959. Professor Spalding, in his second article, recommends symbols for specifying additional conditions which may be controlled by geometric tolerances.
8. Stanley, Reginald E., Sundstrand Aviation, Division of Sundstrand Corp., Rockford, Ill. "Size and Location Tolerances," *Machine Design*, Mar. 5, 1959; "Functional Tolerancing," *Machine Design*, Sept. 1, 1960.

Both articles deal primarily with Maximum Material Condition. The second article relates MMC to sizing checks, and advocates the adoption of Minimum Material Condition, Min-MC, specifications.

Management's Corner

J. M. JURAN, *Editor*

A Note on the Mortality of Q C Departments

"Challenge and response" was the phrase coined by Professor A. J. Toynbee to describe the forces which determined the rise and fall of great civilizations. On a more modest scale, the same forces are decisive in the rise and fall of industrial companies, and of departments in those companies.

Like civilizations, industrial companies are ever faced with challenges in various forms: invasion of markets by competitors; new technical problems; new developments in industrial relations, shifts in the economic climate. Like civilizations, the companies must respond to the challenge if they are to endure.

There is no lack of examples of successful responses. Some have involved the evolution of new species of companies. The corner grocery was succeeded by the chain store, which in turn was succeeded by the supermarket.

Other responses have involved change in the organization form of the company. Decentralized product divisions have, in many cases, replaced functional organizations. Still other responses have consisted of creation of staff departments to perform planning, controlling, and related responsibilities. Modern staff departments such as Product Research, Market Research, Industrial Engineering and Production Control, have all been in the nature of responses to challenges facing industrial companies.

The life history of staff departments is, in microcosm, no less fascinating a study than the rise and fall of civilization. The newborn staff department, particularly, is an interesting subject for study. As a youth it is bright, curious, awkward, eager and even arrogant. Its mistakes are numerous and varied. It may learn from these mistakes and become an accepted member of the industrial community. Or it may fail to learn, and then be swept away with other accumulated dead leaves when the next winter wind blows.

Yet the staff department which survives the period of infant mortality has plenty of perils ahead. The greatest of these is the temptation to find an orderly, settled form of day-to-day life, and to live in peace thereafter, performing these day-to-day duties. Such a concept is squarely opposite to the concepts which result in the creation of staff departments. Staff departments are created because there is a deficiency in day-to-day performance, which cannot be remedied by the unaided "line" departments. As means are found to supply this deficiency, the urge should be to transfer all forms of day-to-day activity to the line, leaving the staff departments free to discover the presence of, and to deal with, new challenges.

Industrial history is replete with instances of failure to understand this role of staff departments. For example, the early industrial engineers were born in a time of few machines and many laborers. Their tools of time and motion study were designed to improve the effectiveness of the laborer. As machines took over the work of the laborer, new problems came over the horizon — materials handling, plant maintenance, control systems, etc. But the industrial engineers continued to do business at the old stand, conducting a day-to-day treadmill of time study, motion study, rate setting. In consequence, new departments had to be created to meet the new challenges. Frequently the new departments, headed by new, imaginative leaders, swallowed up the old. The reasoning of the managers was logical enough. The old department had exhibited inability to recognize and meet the new challenges as well as inability to

turn its day-to-day chores over to the line. Men who evidenced such lack of imagination could not be entrusted with leadership of new, imaginative programs.

There is much reason to believe that the Quality Control Departments in many companies are in just such peril now.

The evolution of the QC department is traceable to the failure of many of the old Inspection Departments to respond to the new challenges posed by the rise in complexity, precision and volume of 20th century products. These Inspection Departments were generally committed to sorting the good from the bad. Prevention was generally limited to sporadic feedback of data on defects. Measuring instruments were designed to sort product rather than to generate control data.

Industrial managers were vaguely aware that the then existing means of dealing with quality problems were inadequate. However, these same managers generally lacked a positive program of what to do. It was this vacuum which created the opportunity for the rapid spread of anything that looked promising.

In this setting, and aided by the fortuitous presence of other conditions, the Statistical Quality Control movement, dropped like a crystal into a supersaturated solution. It sounded new and imaginative, and managers were glad to gamble that the new leadership would solve the company's quality problems. Generally the gamble was lost.

Technique-oriented enthusiasts, lacking a broad understanding of the quality problems of industry and lacking adequate guidance from their management, undertook to apply statistical techniques to any and all situations. Control charts in incredible numbers appeared at factory machines and covered factory walls. Numerous "success stories" appeared in the industrial literature and in management conferences and seminars, in a rising crescendo.

Now that it all has quieted down, there are some useful residual effects. There is a greater awareness of what is the true nature of quality, what are the economics involved, what are the company's quality needs and what is the manner of meeting those needs. And there is a national Society which can aid industrial people to develop the skills needed to deal with these problems.

There is also another widespread residual effect — the conviction of many managers and shop supervisors that "quality control" is a branch of statistics, that the Quality Control Engineer is a statistician with a new label, and that the Quality Control Department is technique-oriented, not problem-oriented. This conviction is completely logical, since it is derived from the repeated assertions, writings and actions of the "quality control" people for more than a decade. These repeated assertions, writings and actions took place not only in the industrial companies. They are equally to be found in the speeches made at conference programs, in the papers published in the journals, and in the type of achievements for which medals and awards were given by the national Society. There is an ironic justice in all this. The attempt to put the label "statistical" on the company's quality needs was at the initiative of the very man who now finds himself so labeled.

We may now return to the peril which confronts many Quality Control departments and managers.

There has always been a need to coordinate all of those activities of the company bearing on the establishment and achievement of quality standards. This need is now becoming so acute that formal organization machinery is being created to do this coordination. At present this movement to formalize is largely seen in the military apparatus programs. However, there is good reason to believe that the movement will in due course envelop the civilian programs as well.

A company which faces an extensive problem in coordination has a range of choice on how to organize for coordination. It may coordinate through the efforts of:

(1) The common boss of the various departments.

(2) A committee of representatives (or heads) of the various departments

(3) An individual project coordinator

(4) A coordination department which is either:

(a) An expansion of an existing department or

(b) Creation of a new department

It is these last two alternatives, 4a and 4b, which concern us here.

A new department called "Reliability" or by some similar label, has emerged as a candidate to do the coordination job. The reasons advanced for creation of a new department are cogent enough. The coordination job is there, and it is broad, including not only manufacture (the asserted limited domain of the Quality Control Department) but also design and usage. Moreover (it is asserted) this broader coordination requires new skills, new approaches and new leadership not available from the Quality Control Departments who (it is asserted) have gotten themselves into a rut.

The validity of these assertions varies greatly from company to company, and is in any event not the main point of this note. The point is rather that there is in fact a movement toward creating such new coordinating departments. The peril to the Quality Control Departments is not merely that they "lose" something which they feel is "theirs"; the real risk is that the Quality Control Department will become subordinate to the new department. This would parallel the way in which the Inspection Departments of the late 1940's and early 1950's became subordinate to the new Quality Control Departments.

Like any other organisms, Quality Control Departments do not take kindly to being swallowed up. There is some stirring and even some collective activity to do something about the common peril. Such is the resolution of the Board of Directors of ASQC, adopted Feb. 19, 1960, which created a Reliability Engineering Technical Committee and which said, in effect, that "Reliability" (and such) is a part of "Quality Control".

It may well be that ASQC can arrange to provide a "professional" base for the "Reliability Engineers" and thus avoid creation of still other Societies to compete for the membership of men associated with the quality problems of industry. However, the decision in the individual companies will be based on the march of events in that company. The more nearly that Quality Control Departments have learned to exhibit problem orientation rather than technique orientation, the greater is the likelihood of their being entrusted to take on new functions.

BOOK REVIEWS

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HANDBOOK OF AUTOMATION, COMPUTATION AND CONTROL, Volume I, Eugene M. Grabbe, Simon Ramo, and Dean E. Wooldridge, Editors, John Wiley and Sons, Inc., New York, N.Y., 1958, 1014 pp., $17.50. Reviewed by Dr. Ingram Olkin, Department of Statistics, University of Minnesota, Minneapolis, Minn.

This volume, entitled *Control Fundamentals* is the first of a 3-volume set. Volume II, *Computers and Data Processing*, has appeared and Volume III, *Systems and Components*, is due to appear this year. The purpose of this Handbook is described by the editors: "This Handbook is directed toward the problem solvers — the engineers, scientists, technicians, managers, and others from all walks of life who are concerned with applying technology to the mushrooming developments in automatic equipment and systems. It is our purpose to gather together in one place the available theory and information on general mathematics, feedback control, computers, data processing, and systems design. The emphasis has been on practical methods of applying theory, new techniques and components, and the ever broadening role of the electronic computer. Each chapter starts with definitions and descriptions aimed at providing perspective and moves on to more complicated theory, analysis, and applications. In general, the Handbook assumes some engineering training and will serve as an information source and refresher for practicing engineers. For management, it will provide a frame of reference and background material for understanding modern techniques of importance to business and industry. To others engaged in various ramifications of automation systems, the Handbook will provide a source of definitions and descriptive material about new areas of technology."

The scope of the Handbook is indeed encyclopedic. Volume I deals with topics of concern in applied mathematics. The main sections are: General Mathematics, Numerical Analysis, Operations Research, Information and Transmission, and Feedback Control. The first three sections will perhaps be of greatest interest to the readers of *IQC*.

The first section consists of 13 chapters entitled: sets and relations, algebraic equations, matrix theory, finite difference equations, differential equations, integral equations, complex variables, operational mathematics, Laplace transforms, conformal mapping, Boolean algebra, probability, and statistics. There is considerable variability in the coverage given to each topic. Some, e.g. differential and integral equations, are moderately extensive, whereas others are somewhat sketchy. The chapter on statistics was found to be incomplete. A more extensive list of references would add to the usefulness of the book.

The section on numerical analysis should prove very useful, in particular, the section on digital techniques in statistical analysis of experiments. The section operations research was written by E. L. Arnoff and contains much of the material from "Introduction to Operations Research," by C. W. Churchman, R. L. Ackoff, and E. L. Arnoff.

The task of preparing such a compendium is a monumental one. In spite of the above comment, this book should ably serve as a reference for workers in the field of computing and data processing.

MATHEMATICAL METHODS FOR DIGITAL COMPUTERS, edited by Anthony Ralston and Herbert S. Wilf, John Wiley & Sons, New York, N.Y., pages vii-293, $9.00. Reviewed by J. N. Snyder, Digital Computer Laboratory, University of Illinois, Urbana, Ill.

This excellent book is unique and fills a long existent need in the area of application of digital computers by providing a central reference where a substantial fraction of the standard methods can be found.

The book is very logically subdivided into six parts: Generation of Elementary Functions, Matrices and Linear Equations, Ordinary Differential Equations, Partial Differential Equations, Statistics, and Miscellaneous Methods.

Each of these parts (with the exception of the first) is further subdivided into chapters, each written by a competent authority in the pertinent field. For example, part two on Matrices and Linear Equations contains chapters on matrix inversion and related topics by direct methods, the solution of linear equations by the Gauss-Seidel method, the solutions of linear equations by the conjugate-gradient method, matrix inversion by the method of rank annihilation, matrix inversion by Monte Carlo methods, and the determination of the characteristic roots of a matrix by the Jacobi method. Each chapter covers essentially one method. However, the editors have been very successful in imposing a very sensible and convenient format on each such chapter. This consists of the purpose of the program or method, a mathematical analysis of the method involving such questions as stability and convergence, the calculation procedures used, a flow chart and its description, and a discussion of the memory requirements and estimated running time, based upon the multiplication and addition times of the machine to be used as parameters. The aforementioned flow charts are constructed in a general fashion and are completely independent of any specific computing machine, as is the entire book.

Since each chapter covers essentially one method, the book cannot be regarded as a complete listing of all possible computing methods which can be brought to bear on specific problems. Some of the methods chosen for description are quite new (for example, several chapters on the application of Monte Carlo techniques). However, most are

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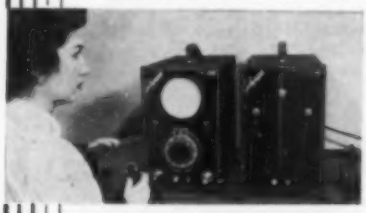

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quite standard by this time. This is really a virtue of the book, because it enables it to act as a reference for such standard methods. An added feature is the excellent references given at the end of each chapter, which enable the reader to easily obtain additional information on the methods described and information about alternate and newer methods on the subject. This list of references is quite up to date, being brought up through 1959.

The level of the book has been well chosen. The derivations are mathematically sound but also should be completely understandable to anyone with sufficient maturity to have been making effective use of computers. The derivations and descriptions of the methods are written in such a way as to be useful to people who wish to make actual computer applications. This is in contrast to the fact that often in the original literature, the mathematical aspects of a new method will be stressed at the expense of descriptions of how to most effectively apply the process. On the other hand, the computer aspects of the book (for example, the flow charts) should be understandable without the necessity of having a detailed knowledge of coding for any specific machine. All that is necessary is a basic understanding of the fundamental concepts of computer application, for example, the necessity of precise definition of the problem, the necessity for anticipating all steps and all contingencies in the problem, etc.

In conclusion, this is the type of book which should offer something to all of the diverse types presently working in the computer area and should be useful addition to their libraries.

STATISTICAL DESIGN, a collection of articles reprinted from *Industrial And Engineering Chemistry*, by Dr. W. J. Youden, American Chemical Society, 1155 Sixteenth St., N.W., Washington 6, D.C., 72 pp., 8½ by 11, $2.00, 1960. Reviewed by Dr. T. N. T. Olson, Industrial Statistics Division, Parke Davis and Co.

This booklet is a collection of two-page articles that were carried bi-monthly over a period of six years, from 1954 to 1959, in *Industrial & Engineering Chemistry*.

Each article is complete in itself and deals with some aspect of statistics. In his first article, Dr. Youden indicated that one of the purposes of his column was to introduce to each other the statistician and the experimentor. Each of the articles, as a result, looks at the problem from both points of view. It is, however, presupposed that the experimentor has some knowledge of analysis of variance and other statistical methods. The series of articles attempts to discuss the reasons and reasoning behind a particular design or problem and makes it appear to be a real life situation. In most cases the discussion is superior to similar text-book descriptions.

Following is a partial list of condensed titles of the 36 articles that are contained in the booklet: established experimental procedures illustrate the principles of statistical design; industrial application requires active support from management; research problems are stimulating the development of new techniques; gun problem illustrates the importance of proper scheduling of measurements; statistical design brings organization and direction into R. & D.; recent advances in design provide guides for research programs; method for fitting lines illustrates procedure for testing hypothesis; the importance of sequential procedure in designing studies; spark plug testing discloses operating characteristics of engines; black box experimenters; a table and a technique in sampling problems and vendor - consignee disagreements; recent developments in factorial experimentation; random numbers or nonsense; interpretation of results; presentation for action, and what is a measurement?

The articles cannot be classed as light reading and must be virtually studied if they are to be of benefit to the reader. The experimental design and that data necessary for clarity are presented for each problem. The method of calculation is left to the reader.

This series of short articles will undoubtedly be of interest to those individuals interested in the reasoning process of experimental design.

PRINCIPLES OF ENGINEERING ECONOMY, (Fourth Edition), by Eugene L. Grant and W. Grant Ireson, Ronald Press Co., New York, N.Y., 574 pp., $8.00. Reviewed by Ralph Swalm, Professor of Industrial Engineering, Syracuse University, Syracuse, N.Y.

In reviewing the fourth edition of a book that has become a classic in its field, one naturally looks primarily to differences between the fourth and previous editions. Successive editions of Grant's "Principles of Engineering Economy" have long since earned such a place in the field of engineering economics. The fourth edition, in the writing of which Professor Grant has been joined by his colleague, Grant Ireson, promises to continue this tradition.

To this reviewer's eyes, the major change in the new edition has been a much more intensive examination of the effects of taxes on economic decisions. Out of this has grown a greater emphasis on the present worth approach, which is somewhat better adapted to detailed tax calculations than the annual cost approach which dominated previous editions. Grant and Ireson's treatment of tax considerations is truly outstanding, and it alone justifies the issuance of a new edition.

Another welcome change in the new edition includes a considerably more extensive set of interest tables. These include tabled values of the traditional factors for interest rates up to 50 percent, gradient factors, and tables for continuous compounding. These latter are tabled in terms of the effective rather than the nominal interest rates — a choice which, through unusual, seems a most happy one.

On the negative side, this reviewer feels the delegation of the approximate method of calculating the cost of capital recovery (by use of the annual cost without interest plus the average interest) to an appendix is most unfortunate, since this method has some very real advantages in practical use. Although he would agree that the use of a model based on the prediction of a single, most likely value for a future income or outgo is justified in a first course, or an elementary text, more discussion of the rationale behind this simplification and at least a brief look at the possibilities — and problems — associated with the use of a model assuming a probability distribution would be desirable. True, in one example, the use of a mortality distribution is discussed, but the matter is dropped there.

Perhaps at least a brief mention of some of the factors that have made this entire series of editions so widely accepted is in order. There are so many of these that any listing will be partial, and perhaps serve only to show the reviewers bias. Most such lists, however, would probably include an excellent treatment of fixed and increment costs, a fine approach to teaching through the use of examples, a good selection of problems, and the thoroughness with which each topic considered is handled. These traditions

Metals Technical Committee

The 27th meeting of the ASQC Metals Technical Committee will be held Feb. 9-10, with S. S. Lewis, Jones and Laughlin Steel Corp., Pittsburgh, Pa., as host.

The 26th meeting was held Oct. 20-21 at the Sheraton-Cleveland Hotel, Cleveland, Ohio. The regular meetings of sub-committees and full committee were held. The problem seminar was also included.

Several subcommittee reports of activities have been bound, distributed and made available through the ASQC Metals Technical Committee.

are all continued in the present edition, and it can therefore be expected to attain the same wide acceptance accorded its predecessors.

SINTESIS DE UN CURSO DE CONTROL ESTADISTICO DE CALIDAD (*Outline of a Course in Statistical Quality Control*) by Domingo M. Lopez and Enrique J. Gonzalez L., American Society for Quality Control, Seccion Cuidad de Mexico, 1960. 68 pp. Reviewed by Charles H. Proctor, Department of Experimental Statistics, North Carolina State College.

The first part of this course outline gives instructions for constructing an apparatus to simulate sampling of attributes, for tallying observations, for plotting fraction defectives, means and ranges with limits. The second part illustrates the computation of standard deviation, mean and median, making significance tests, using tables of normal curve areas. "Multy-Vary Graphs," acceptance sampling plans and treats some cost considerations. The author's frequent use of numbered procedural steps and illustrations by concrete rather than hypothetical examples shows their concern with applications. The specificity of the examples, the lack of tables, and the superficiality of the statistical theory belie the fact that this publication was intended to be used in any way other than in conjunction with a more formal course.

OPERATIONS RESEARCH: Methods and Problems, by Maurice Sasieni, Arthur Yaspan, and Lawrence Friedman, New York, N.Y., John Wiley and Sons, Inc., 1959, pp. xi-316, $8.50. Reviewed by A. Clifford Cohen, Jr., University of Georgia.

This book is proposed as a text for a one-semester course in *Introductory Techniques of Operations Research* at either the beginning graduate or the advanced undergraduate level. Readers are presumed to have a working knowledge of differential and integral calculus plus an understanding of statistics equivalent to that which might be obtained from a one-semester introductory course.

There are ten chapters, of which the first three are preparatory and bear the titles: Introduction, Probability, and Sampling. The last seven chapters are devoted to various operations research problem areas and bear the titles: Inventory, Replacement, Waiting Lines, Competitive Strategies, Allocation, Sequencing, and Dynamic Programming. Also included are three appendices entitled: Finite Differences, Differentiation of Integrals, and Row Operations.

The authors' approach in developing their various subjects is mainly through the medium of worked examples against a background furnished by a discussion of the relevant problem areas. A number of well-chosen exercises to be solved by the student are included at the end of each chapter.

This is a good introductory book in a field where little is currently available and the authors are to be commended for their efforts. Unfortunately, the chapter on Probability will likely seem disappointing to one who is mathematically trained. The language is not always precise, and distribution parameters are not clearly distinguished from their estimates. For example, on page 21 and elsewhere in Chapter 2, $\bar{x}$ is improperly employed to designate the distribution mean; whereas in the next chapter, consistent with current statistical usage, it is correctly used to designate the sample mean. This may have resulted from the authors' attempts to present a "working" rather than a rigorous development of probability theory. Nevertheless, in spite of these and other minor deficiencies, it is the opinion of the reviewer that a copy of this book would make a worthwhile addition to the library of a quality control engineer who desires an introduction to the fundamental techniques of operations research.

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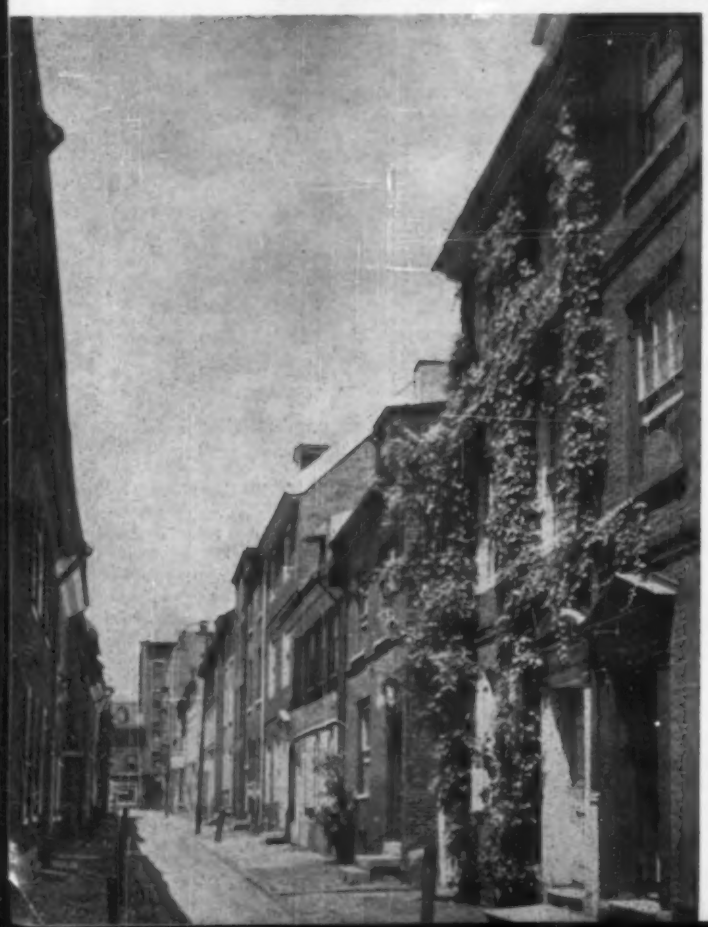

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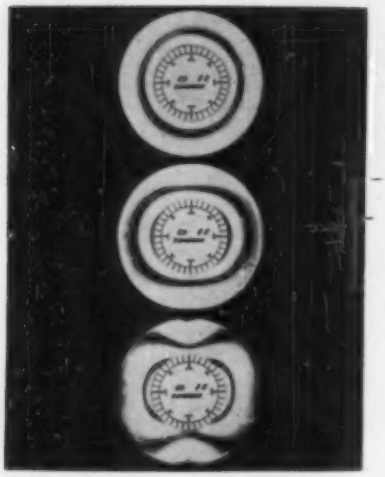
What's New?

ROY A. WYLIE, *Editor*



P-2-12—A new PhotoStress Rosette Gage has been put on the market which is the only gage of its kind to provide directly both orientation and separate magnitudes of principal strains. This important feature, coupled with the gages' speed and ease of application, promises to greatly simplify stress analysis problems for which they are used. The Budd Company's PhotoStress Rosette Gage has a wide range of applications. Among them are installation on such large structures as reinforced concrete or steel bridges, or on such varied big mechanical assemblies as railway and automotive frames, ocean-going ships, aircraft and large missiles. According to the Budd Company, measurements of principal strain directions are possible for strain levels as low as 50 microinch/inch and up, major and minor principal strain directions obviously apparent, separate magnitudes of strain obtained directly along desired axis, high readout sensitivity due to permanent pattern, constant sensitivity for directions and magnitudes for any strain level, and proved PhotoStress technique (Zandman method). The unit provides direct readout — no instruments or electrical connections, static or dynamic (with strobe light) reading, sensitivity and zero stable with time, unaffected by humidity, and easily bonded at room temperature to metals, concrete, wood and other materials. The unit will not perform accurately in areas of high strain gradients. In these areas, use classical PhotoStress or miniature type MetalFilm strain gages.

* * *

P-2-1—Interchangeability of gaging heads on Mahr Self-Centering Bore Gages is reported by the Mahr Gage Co. Mahr is using Precision Comparator Gaging Heads, reading directly in 20 millionths, 50 millionths or ½-thousandths of an inch, instead of dial indicators. They may be interchanged in any Mahr Bore Gage Set within range from 0.059 to 32.000 inch in diameter. Only *one* gaging head has to be purchased for all sets, since it fits all ranges. But gaging heads with finer or coarser graduations respectively may be interchanged at any time if the job requires different tolerances. Mahr Precision Comparator Gaging Heads employ a level principle for their amplifying mechanism instead of a gear principle, such as ordinarily used in dial indicators. Measuring pressure is transmitted by means of a precision ball rolling over a highly lapped plane sapphire surface. Thus the measuring accuracy is maintained within a fraction of one graduation of 50 millionths of an inch unaltered for the lifetime of the instrument. Mahr Self-Centering Bore Gages are high precision instruments, although they are inexpensive. Extensions for deep bores up to 80 inches additional depth are available. For the measuring of bores at hard-to-get-at places, Right Angle Attachments or Right Angle Bore Gages can be furnished. The checking of mass-produced small parts can be speeded up by a special Precision Comparator Stand. Illustrated folder with full specifications and complete price information may be obtained.

* * *

P-2-2—The new Beckman Model 930 Air Comparison Pycnometer is described in a brochure recently published by the Scientific and Process Instruments Division of Beckman Instruments, Inc. Rapid, non-destructive volume measurements for density and porosity determinations of irregular, powdered, and porous solids are now possible with the new Beckman instruments. The device is completely hand operated and requires no power source. Applications of the Beckman Pycnometer include ore sample and mineral purity evaluation, grading of pressure expanded cereals and other foods, core analyses for percent porosity and density in petroleum production, determination of the density of powdered and granular polymers, grading of compressed and woven fibers, density measurements in engineering materials, and porosity calculations on bearing metals. The Air Comparison Pycnometer requires no liquids, no gas pressure determination, and no temperature control. Volume measurements accurate to better than 0.1 cc. can be obtained by the most inexperienced operator. A complete measurement may be made by an unskilled operator in one minute and without wetting or damaging the sample. Problems of wetting, bubbles, flotation, temperature control, and solubility common to liquid displacement measurements are eliminated.

P-2-9—National Astro Laboratories, a Quality Assurance and Instrument Calibration Service firm, has announced the operation of its first mobile, on-site calibration unit. As more military and industrial facilities become aware of this service, more units will be added to the mobile calibration fleet. The first trailer is now providing metrology and inspection service to one of the local major airframe and missile systems manufacturers. Due to the heavy work load already realized by the customer's calibration and standards group, the NAL mobile service unit is instrumental in helping the client meet his production and shipping schedules. Other trailers will be equipped with specific test and calibration equipment, designed to meet customer requirements in the fields of electronics, pneumatics and hydraulics. These on-site units can be equipped and placed into operation, almost overnight, to meet the specific requirements of a project. Because there is no need for additional overhead burden, personnel or capital outlay, users of the service realize significant economies. Limited

Our Cover

Optical Comparators Aid Reliability Aim

We are indebted to Motorola Inc., Military Electronics Division, for our February cover picture.

Motorola employs modern optical comparators for precision inspection of small parts and components in the production of extremely reliable military electronic products.

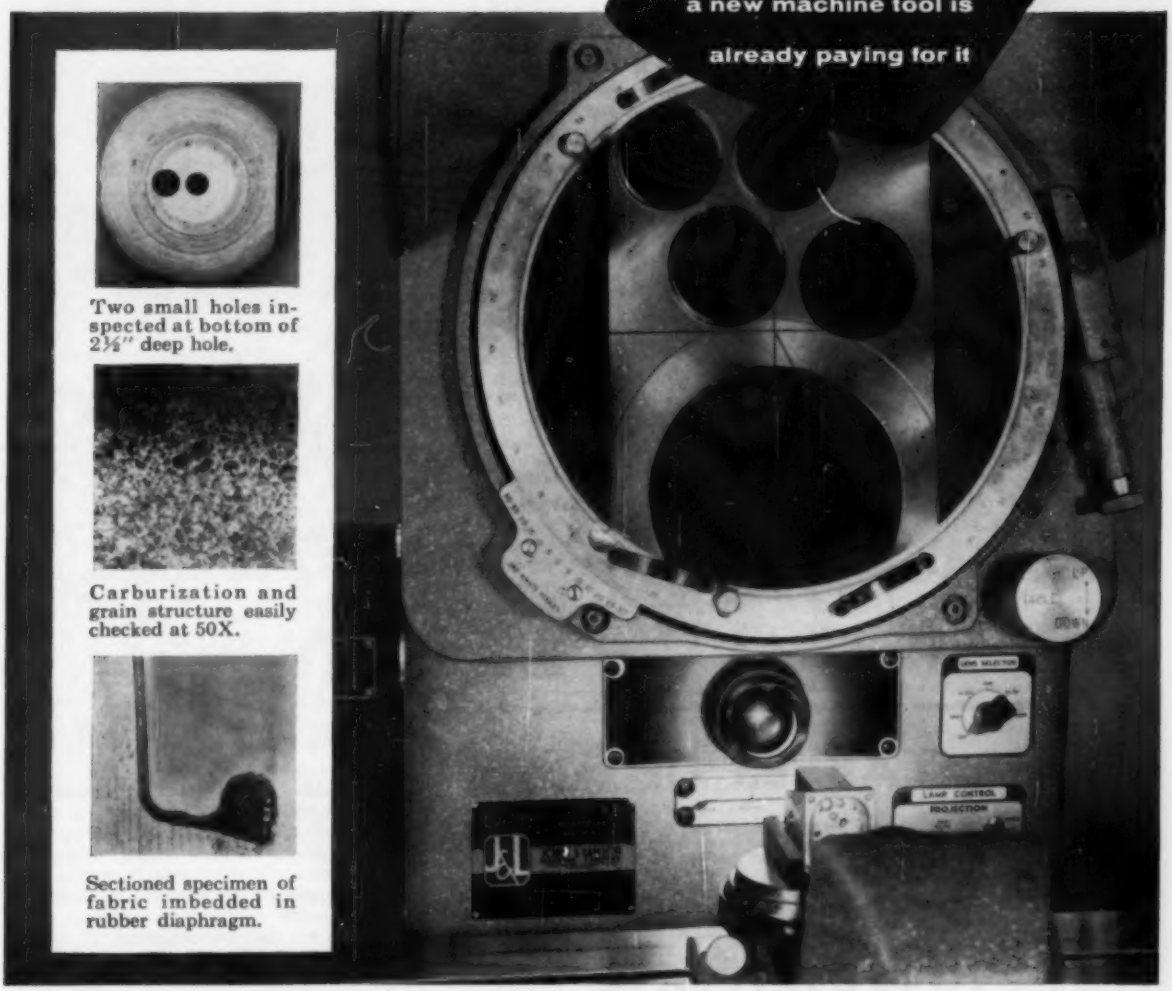
JONES & LAMSON
OPTICAL COMPARATORS

the man who needs
a new machine tool is
already paying for it

Two small holes inspected at bottom of 2½" deep hole.

Carburization and grain structure easily checked at 50X.

Sectioned specimen of fabric imbedded in rubber diaphragm.



New reflection unit makes "tough" inspections easy

Now, users of J & L FC-14 and TC-14 Optical Comparators can easily and accurately inspect cast materials, deep holes, and penetration of heat treat, and can make their over-all inspection operations more efficient than ever before.

J & L's new Normal Reflection Unit, shown here, is designed to produce the maximum amount of reflectivity, *regardless of the surface finish of the part being inspected.* This new unit gives brighter-than-lifelike images, with clean, razor-sharp definitions, without heat and without distortion.

This revolutionary development makes it possible to inspect by reflection and by projection simultaneously. Reflection can be directed from above, below, or either side. Effective light is increased at least 55% by means of a spherical reflector, which concentrates and redirects light into the optical system.

With J & L's True Telecentric Lens System, depth of focus of up to .100" can be obtained. And the image does *not* change size during focusing! The entire unit, is externally mounted to isolate convected heat from the optical system.

Write for free, illustrated folder LO-5918. Jones & Lamson Machine Company, 510 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

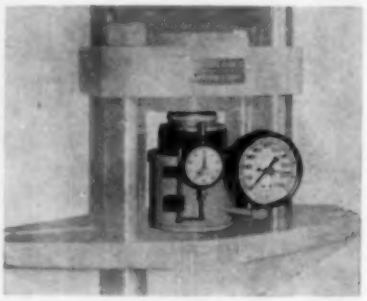
duration projects as short as three to four weeks are feasible. Service operating costs are reduced as the result of an improved learning curve/time relationship for longer term projects. An article recently prepared by Mike Rothbart entitled "The Industrial Need for a Standards Laboratory" illustrates some of the problems faced by NAL customers who are military contractors. A copy reprint is available upon request.

* * *

P-2-3—A four-page Data Sheet describing two new transistorized, continuous indicating Conductivity Monitors is available from Leeds & Northrup. Installation connections for conductivity measurement systems, circuit diagram, and pertinent features are described for two types of monitors: Industrial Model and Portable Model. Also included is a table listing available conductivity ranges and types of assemblies for automatic temperature compensation.

* * *

P-2-6—General Electric has introduced a tape-controlled automatic relay tester which presents performance-test results immediately as useful process control information. Known as a "Quality Information System," the equipment will be built and marketed by the G-E Specialty Control Department. It employs a new method of classifying information by converting absolute measurements into "cellular" form. Results, including decisions to accept or reject each tested unit, are presented both by visual readout device and recorded on a standard printer. The system presently provides cellular classification of eight parameters and presents the data in a form which readily can be used to correct process deviations from normal before scrap has been generated. The programmed tester presently provides such information on tests for coil resistance, contact resistance, pickup voltage or current, drop-out voltage or current, pickup bounce time, drop-out bounce time, pickup operate time, and drop-out operate time. Studies by the department indicate that savings accruing from the speed and accuracy of the tester will allow it to pay for itself in less than a year and a half. Important additional savings are inherent in the ability of the tester to provide timely, uniform process control guidance, the department points out. A self-contained unit, the tester is programmed by a standard punched tape which directs type and sequence of tests. Functional performance limits for each type of relay tested are inserted on punched cards. All programming, inputs, switching, analysis and decision, and readout units are included in the system. Modular construction of the tester, plus its unique method of cellular classification, makes it adaptable to use with other electrical components as well, according to the department. It may be assembled to meet the specific electrical testing needs of each user.



P-2-11—A self-contained adapter unit permits existing compression equipment to be used in making ductility tests on sheet metal up to 1/16 inch thickness. Named Sheet Metal Tester Cell (Model CTC), the new unit is the result of over a year of development work by Detroit Testing Machine Co. Tests by the company show that this inexpensive unit offers results as accurate as those of machines costing three times as much. The Tester Cell is a compact unit weighing 22 lbs. It may be used in conjunction with a wide variety of compression loading equipment for performing ball punch and cup type ductility tests.

* * *

P-2-13—The Davidson Coordinate Autocollimator, D-638, is an angle reading instrument that measures the angle through which an external mirror is displaced from the optical axis of the autocollimator. The external reflecting surface, from which the autocollimator works, need not be illuminized to achieve more than satisfactory operation. This increases the usefulness of the autocollimator by being able to work from optically flat surfaces other than mirrors. Equally important is the fact that the reflecting surface can be as small as ¾ inch in diameter. The field of the autocollimator is dark except for an illuminated annular fixed reticle, and a black line reticle. This feature was incorporated so that quicker initial readings could be taken, as well as lessening eye fatigue. Alignment is made by simply turning the scale knob until the line reticle moves across the field and bisects the center of the annular reticle. Both minutes and seconds are read from drums adjacent to the eyepiece, thus enabling the operator to tell at a glance what the reading is. The eyepiece can be turned through 90° for measuring in both the horizontal and vertical plane, or set in an intermediate position between the two

TABLES OF THE HYPERGEOMETRIC PROBABILITY DISTRIBUTION

GERALD J. LIEBERMAN and DONALD B. OWEN

For the first time, the hypergeometric probability distribution is extensively tabulated. Heretofore, the function has been approximated, usually by means of binomial and Poisson distributions; now the results of exact machine computation are available. Values of N are given from 1 to 50 in steps of 1. Values greater than 50 are given with increasing intervals, particularly where approximate methods cannot be used to the required accuracy. The Introduction to the tables presents a detailed summary of the method of calculation.

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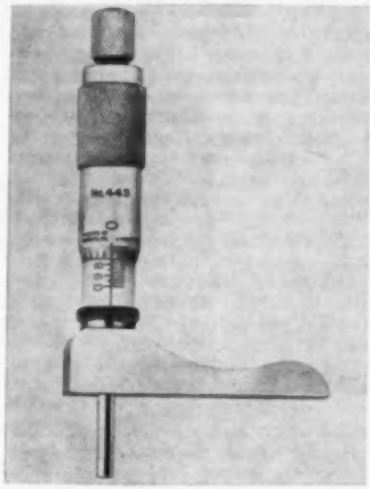
planes for measuring obliquely tilted surfaces. Although the autocollimator has a focal length of 20 inches, it is a folded 20 inch system with the overall length of the autocollimator being only 12½ inches. This allows the operator to make adjustments to the external mirror while making observations in the eyepiece. To give the operator the most comfort, the eyepiece has been tilted back from vertical. Davidson makes another instrument, the Twin Axis Automatic Autocollimator, Model D-707, which combines optics with electronics to measure the motion or position of an external reflecting surface with respect to two perpendicular axes. The optical system projects a beam of light, looks at the return reflection, and automatically measures the angle between the outgoing beam and the return beam by re-directing the return beam to bring it on center. The re-direction is accomplished in terms of orthogonal components by means of servos and a pair of Davidson's patented tipping plates. Read-out dials and pots are linked to the tipping plates. Since the servos have a nulling function, and since response is a matter of self-consistent phase relationships, the D-707 is insensitive to light intensity, warm-up, line voltage and frequency, and distance to the external reflector (up to 25 or 50 feet). Over a range, the size of the reflecting surface is immaterial. There is no appreciable cross-coupling between axes. Any single external reflector need intercept only a portion of the outgoing light beam. Therefore, the valuable techniques of aperture sharing may be employed. When the return reflection is coincident with the outgoing beam, the D-707 reads center-scale on each dial, and the pots read zero output. With a.c. on a pot, its output is phase reversible and increases linearly either side of center; with d.c. the output is polarity reversible and increases linearly. The d.c. is used, as a rule, when the pot output is to be connected to a recorder; a.c. is used when the pot unbalance signal controls an external servo that will align the external reflector until zero error is left. The D-707 may be positioned to allow the axes to have any direction with respect to horizontal and vertical.

* * *

P-2-7—A further advance in the field of non-destructive Hi-Pot testing is announced by the Arizona Instrument Corp. The Model T combination Hi-Pot and insulation tester offers two separate power supplies providing 0-3500 volts d-c for standard Hi-Pot requirements and 0-200 volts d-c for tests on small capacitors, transistors and the like. Leakage current ranges of 1, 10, and 100 micro-amps are also provided. The tester still provides the unique protection of a fail-safe circuit which automatically removes the test voltage when the predetermined leakage current level is exceeded providing safety for the components tested and safety for the operator. Rack mounted unit (Case style #5) weighs 22 pounds and measures 7" x 19" x 7". Price: $680.



P-2-4—A new series of micrometer depth gages introduced by the L. S. Starrett Company, features a short half base designed to facilitate depth gaging close to shoulders or between obstructions where ordinary full gages will not go. Available in three size ranges — 0 to 3 inches with three rods, 0 to 6 inches with six rods or 0 to 9 inches with nine rods. Sleeve and thimble on these No. 443 Series Micrometer Depth Gages have no-glare Satin Chrome Finish. Graduations are in thousandths of an inch. The screw is precision ground with a one inch movement and the base is hardened, ground and lapped. New Tools Bulletin No. 143, available on request, gives complete information.

* * *

P-2-14—Rex Gauge Co., Inc., makes two hardness gauges — the Rex "Vest Pocket" Hardness Gauge Model 1500, and the Rex Laboratory Model 1600, priced at $59.50 and $89.50, respectively. Model 1500 may be used in any position, has nothing to wear out or break, vernier reads directly to 5 Durometer points, and interpolates to two points with average vision, has easy reading, widely spaced graduations, no gears, cams, levers, all parts wear and corrosion resistant and sealed springs never require recalibration or adjustment. The Model 1600 produces readings of plus or minus ½ Durometer point consistently and indefinitely, never needs recalibration or adjustment, creep readings easily noted by action of the dial hand, and a large dial, full 360° sweep, gives unequaled ease of reading. Model 1500 is furnished in a leather pocket sheath, and Model 1600 comes in an individual mahogany case.

* * *

P-2-10—A compact battery-operated vibration calibrator (Type 1557-A), with which one can calibrate accelerometers, vibration pickups and vibration meters, as well as other vibration-measurement systems that use small, crystal-type accelerometers as sensing elements, has been announced by the General Radio Company. Consisting of a transistorized electromechanical oscillator and a battery-operated cylindrical shaker, the instrument provides a standard acceleration for 1 g (rms) at 100 cps. Acceleration output appears at two pillbox-shaped 50-gram discs mounted on an internal cylinder extending through the instrument and projecting at the sides. The pickup to be calibrated is attached to, or in place of, one of these discs. Acceleration accuracy is ±10 percent; frequency accuracy is ±1 percent. Oscillator amplitude can be adjusted by a panel *level* control, and in this way, the calibrator is adapted to pickups of different masses. To subject a pickup to an acceleration of 1 g at 100 cps, one simply adjusts the *level* control until the panel meter, calibrated in grams, indicates the mass of the pickup. The only

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Complete unit consists of transparent plastic container, opaque colored beads, and wood paddles permitting easy identification of beads at a distance.

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other control on the instrument is a combination on-off switch and battery checker. Power is supplied by four RM-Y mercury cells, whose life is 100 hours. The total weight of the instrument, including a leather carrying case, is 3¼ pounds. Dimensions are 4" x 8" x 4". Price of the 1557-A is $225 net, f.o.b. shipping point.

P-2-5—Owen Laboratories, Inc., announces a new sophisticated portable precision laboratory semiconductor test set, Type 310, for accurately measuring operational parameters and leakages of small and medium transistors, rectifiers, and zener diodes. The standard "h" parameters of transistors may be measured at constant emitter current up to 100 ma, and constant collector voltage up to 30 volts. Rectifier diodes may be measured with up to 100 ma forward current. For zener diodes, 65 ma is available at 10 volts, 50 ma at 15 volts, and 30 ma at 20 volts. Leakage and reverse current test potentials range to 600 volts. The test set is completely self contained, working from 115 volt 60 cycle a-c line. Test frequency, using the built in oscillator, is 1000 cps. With accessory devices the test set may be used for measurements of d-c current gain, alpha cutoff frequency, beta cutoff frequency, collector capacitance, and other characteristics. Designed expressly for those engaged in the design and development of equipment using transistors and diodes, the simplicity of operation and ease of accurate direct meter reading combined with the ability to scan through tests for many different parameters without changing operation condition settings makes this set a valuable tool in quality assurance inspection as well as in the engineering laboratory. Size is identical to the 30-ampere test capability Owen Type 300 power transistor test set; 17" wide x 15¾" high x 7" deep. Weight is 35 lbs. Available from stock: $685.

* * *

P-2-8—The Mueller patent pending "Hard Chrome Height Gages" have 50 widely spaced graduations; eliminates use of magnifying glass. The specially drawn tubular beam is balanced in appearance with stability throughout its entire length with a specially designed friction roller unit. The much-desired elimination of backlash while setting the gage has been achieved. Gage comes in inch and millimeter graduations. Sizes are available with fitted case in 12", 18", 24", 36", and 48" lengths.

New Literature Available

L-2-1—The new Jones Metrola Corporation Catalog is of interest to anyone having problems of speed measurement, production control, or quality control. It contains photographs and drawings and descriptions of 19 distinct types of Jones Tachometers, together with drawings of various types of flexible shafts and drives and drawings of various drive arrangements. A copy of Catalog 62 will be sent to anyone upon request.

* * *

L-2-2—Five Recommended Practices have just been issued by the Instrument Society of America, through the work of its Standards and Practices Department. In accordance with Society practice, each of the new RP's has been issued with a tentative status. Two of the five are concerned with Dynamic Response Testing of Process Control Instruments. One, ISA-RP 26.2, Devices with Pneumatic Output Signals, the other ISA-RP 26.3, Devices with Electric Output Signals. The two are based on recommendations contained in ISA-RP 26.1, issued in December, 1957. The RP 26 series has been described as constituting a major contribution of ISA to the instrument technology. These latest RP 26 Recommended Practices are the result of three years of work by a committee of the Standards and Practices Department, and a board of review of over 40 members representing manufacturers and users in the United States and abroad. Specific load configurations and test signals for dynamic testing of pneumatic and electric process control instruments are contained in these latest RP's. Also, recommendations for optical dynamic tests which will characterize the reset and derivative functions of pneumatic and electric controllers. Each contains a "tear-out" sheet summarizing the recommendations for rapid reference in testing laboratories. Copies of RP 26.2 and/or 26.3, may be obtained — 50c to ISA members; 75c to nonmembers. Two other RP's are concerned with installation of electrical instruments in hazardous atmospheres. These are ISA-RP 12.1, and ISA-RP 12.4. The first provides recommended methods of installation. It is intended as an introduction to a series of recommended practices to be issued by ISA, each dealing with a specific protection method. It also covers in detail several often overlooked aspects which are common to each of the various methods of protection. RP 12.1 is 50 cents to members. ISA-RP 12.4, is 75 cents ISA members, and 75 cents to non-to ISA members and $1.25 to nonmembers, covers a specific phase of installation of electrical instruments in areas of explosion hazards and gives a technique for reducing haz-

Western Regional Conference, EVOP Course March Events at Anaheim, California

This year the Western Regional Conference on Quality Control and Reliability, Mar. 15-17, will follow a Chemical Division EVOP course, Mar. 13-14, at the Disneyland Hotel, Anaheim, Calif.

The Conference will include sessions on fundamentals of QC charts and acceptance sampling; management of QC and reliability; an inspection workshop; symposium on the reliability of the Minuteman, recent advances and applications of statistical theory, and a panel on QC in the metal industries.

Speakers will include J. Y. McClure, president, ASQC; Capt. W. A. Hasler, Jr., U. S. Navy; John R. Moore, president, Autonetics; Professor Edward Coleman, UCLA; Dr. Leslie Ball, Boeing Airplane Co.; R. Calvert Haws, Quality Control Engineers, Inc.; Frank Squires, Consultant, Dr. Benjamin Epstein, Stanford University; Dr. D. B. Owen, Sandia Corp., and Dr. Harry Romig, Operations Research, Inc.

Registration will be conducted the afternoon of Mar. 15, with Conference sessions Mar. 16-17. Contact C. L. Kleppsattel, Hughes Aircraft Co., Newport Beach, Calif.

The Evolutionary Operations course will be sponsored by the ASQC Chemical Division and Los Angeles section. The committee includes Arnold A. Rothstein, chairman; Paul Leatherman, secretary-treasurer; Jesse Black, publicity, and Richard Biedenbender, arrangements.

Evolutionary Operations, or EVOP, is a method of running an operation or process to get information on how to improve the process (or save money!) while making specification grade product.

Instructors will be Paul Tidwell, Monsanto Chemical Co., and Robert Hunter.

Contact A. A. Rothstein, c/o Space Technology Laboratories, Bldg. 4, Rm. 191, 5730 Arbor Vitae St., Los Angeles 45, Calif. Course fee $100, payable to EVOP Course, L.A.

ard classification by purging with air or inert gas. Purging for this purpose has been widely resorted to for many years, but wide differences of opinion exist as to specific purging requirements. RP 12.4 classifies the situations in which purging is to be used, and provides logical requirements for each classification. The fifth Recommended Practice (ISA-RP 3.2) just issued is designed to establish recommended materials of construction; uniformity of tolerances, and symbols for dimensions, as well as uniform identification practices for flange-mounted, sharp-edged, orifice plates for flow measurement. Copies are 50 cents to ISA members; 75 cents to non-members.

* * *

L-2-3—A newly revised publication, American Standard Requirements for Instrument Precision Ball Bearings, B3.10-1960, has been approved and published by the American Standards Association. This revision supersedes American Standard B3.-10-1959, and redefines the characteristics of instrument precision ball bearings. The original standard was completed during the summer of 1958 by ASA Sectional Committee B3, ball and roller bearings, and finally approved in January 1959. The revision was submitted by the American Ordnance Association committee, endorsed by Sectional Committee B3, and approved by ASA in April, 1960. A table of metric series has been included in the 1960 edition which reflects the work in progress on international modifications through agreements reached on international levels. The standard covers boundary dimensions and tolerances, size classifications used for selective assembly, internal radial clearances, and other requirements for instrument ball bearings, which have refined dimensional and performance characteristics in comparison with conventional ball bearings. Typical application for instrument bearings include gyroscopes for spin mass and gimbal support, and for synchros, resolvers, small servomechanisms, computer gear trains, recording devices, sensitive potentiometers, optical mechanisms, and magnetic recorders. These are used for ground, marine, and airborne navigational and ordnance equipment of many types, and are finding increased civilian use in the computer and dental equipment fields. American Standard Requirements for Instrument Precision Ball Bearings, B3.10-1960, is available at $1.00 per copy.

* * *

L-2-4—Telonic Industries have announced the availability of their new, 60-page catalog on RF test equipment. The new catalog contains complete descriptions of Telonic's wide line of RF Sweep Generators and other RF test equipment and components for laboratory and production line applications. In addition, an entire section of the catalog is devoted to descriptions and specifications on many accessory items for RF testing, allowing the design or production engineer to select a complete RF test set-up from one source. These accessories include turret and taggle-switch RF attenuators, RF detectors, RC oscillators, and low pass, band pass, and tunable RF filters. A complete, current price list and the addresses of all Telonic representatives are included. Copies of the new Telonic General Catalog may be obtained by request.

* * *

L-2-5—Technical Memorandum No. 1, 9 pages, "Statistical Data Reduction and Control Systems", discusses methods for increasing efficiency of data reduction and automation systems for quality control, continuous processing, and large scale experimental work. Need for statistical reduction of data prior to readout is stressed. Free copy upon request.

* * *

L-2-6—A new service from Controlled Environment, Inc., which provides complete, pre-engineered "clean" or "white" rooms in one package at one price — including installation and employee training— is described in a four-page bulletin. A pictorial sketch illustrates 31 construction and operational details of typical dust-controlled clean rooms.

* * *

L-2-7—To provide thousands of engineers, technicians, and specialists now working in electronics and allied fields with a sound foundation in semiconductor circuitry, a new course — principles of semiconductor-transistor circuits — has been developed by International Correspondence Schools.

* * *

L-2-8—Radionics has published a new catalog sheet which describes their new line of cobalt 60 panoramic radiography cameras.

* * *

L-2-9—Diversa Electronics, manufacturer of Q-Trol, a low-cost, high reliability, quality control computer, announces the availability of a folder which shows how Wald's Theory for Sequential Analysis for random sampling method of statistical QC increases profits for manufacturing and mass-service types of business and amazingly eliminates waste materials and motions, reduces personnel and operating costs, and upgrades quality for improved customer relations.

* * *

L-2-10—"Pocket Guide to the Proper Selection of Digital Measuring Instruments," a 10-page folder on factors to be considered in purchasing a digital voltmeter, has been announced by Non-Linear Systems, Inc.

New micrometer can measure internal lands and grooves to ± .0005" ...on the machine!

Now, for the first time, you can measure internal lands and grooves, O-ring widths, retaining ring grooves, keyways, and cylinder grooves simply *and accurately*. The new Multi-Mike* internal groove micrometer operates just like any conventional micrometer. Easy-to-read Starrett micrometer head has graduations in thousandths of an inch. Multi-Mike can reach into, and measure, bores as deep as 5¾"; the two standard models fit holes down to ½" or ¼" diameters. The Multi-Mike measures groove widths from .050" to 1.050" and lands from 0 to 1.000". And this amazing new internal micrometer can do all this while the piece is still on the machine!

Multi-Mike produces higher quality work with lower cost set-ups and fewer rejections... gives you greatly reduced inspection and quality control costs. Write today for free literature.

*TRADEMARK; PATENT PENDING

Multi-Mike Micrometer is another invention marketed by:

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section briefs

Guests at the November meeting of the Boston section included J. Y. McClure, president of ASQC. From the left—R. G. Fitzgibbons, Abraham Kaplan, George Mason, Mr. McClure, and William A. Donovan.

AKRON-CANTON . . . Nov. 17, Management Night, Ed Schrock "Modern Inspection" well received . . . Used an intricate "mobile" to show interactions and relationships among the many factors which influence quality costs . . . Guest—Keith Lewis, District representative . . .

Feb. 16, Richard M. Cyert "Sampling Techniques for Management" . . . Speaker in charge of School of Industrial Management, Carnegie Tech . . . Author, lecturer, and consultant in QC and statistics, economics, and accounting.

The Education committee is making final arrangements for training courses IQC Numbers One and Two, which will start in Canton the latter part of February.

H. P. Pierce

ALBANY . . . Nov. 3, afternoon session by John W. Maillet, QC manager, Schenectady GE Tube plant . . . Implementation of Total QC in the manufacture of electronic tubes has been underway for 18 months—splendid progress . . . Talk brought home to us the costly consequences of momentary lack of control and explained with clarity the ways GE determines capabilities in advance . . .

Evening session by Frank McLaughlin "How to Plan for Process Control" . . . Talk delivered with the rare combination of wit and wisdom that makes him so much in demand . . . Mr. McLaughlin a member of the QC Services Group, GE, with headquarters in New York City . . . QC problem experience in scores of GE plants . . .

M. P. Flanagan

ALLENTOWN-BETHLEHEM . . . November meeting, plant tour of portions of the giant Bethlehem Steel Company facilities, Bethlehem, Pa. . . . Our thanks to Charlie Weeks, arrangements committee chairman, who arranged this visit, and to Bethlehem Steel . . .

Irv Yeager, Western Electric Co., Allentown, Pa., publications chairman, announced that the International Cooperation Association, Washington, D.C., an agency of the Federal Government, has recently placed an order for 100 copies each of our three training manuals. These manuals, "Introduction to QC," "Practice of QC," and "Sampling Inspection," have been developed over a period of years by members of our section for use in our own training classes. We are happy that others find our work is of benefit to them.

David F. Roberts

BALTIMORE . . . Nov. 11-12, Middle Atlantic Region and Tenth Annual Aircraft and Missiles Division Conference, Lord Baltimore Hotel, Baltimore, Md. . . . Baltimore section host . . . attracted 250 persons . . . Keynote address by Paul W. Howerton, Central Intelligence Agency . . . Topic—"Technical Information Exchange: Prime Requisite for Scientific Achievement" . . . Discussion topics included quality audit as an administrative control, reliability specifications, inspection and testing, nomography, a stimulating brainstorming session on new and different ways to motivate people in having pride of workmanship, educational subjects, the use of quality control teams in a QC program . . .

A special ladies program was also arranged to give the ladies an opportunity to see historic Baltimore and to learn something about the field of QC and Reliability. Our Mrs. N. McAfee took care of the girls.

General chairman was Bill MacCrehan, Bendix Radio Division, Baltimore, Md.

A. M. Reek

BATTLE CREEK-KALAMAZOO . . . November meeting, KVP-Sutherland Paper Co., Dr. Brant Bonner, Dow Chemical Co., "Evolutionary Operations in Industry" . . .

Feb. 16, Lansing, Mich., Curtis Williams, QC, Aircraft Gas Turbine Division, GE, Evandale, Ohio, with "Outgoing Control of Quality and Customer Complaints." . . . Speaker has spent 27 years in inspection and quality control with Chevrolet, GMC, the War Department, Soreng Manufacturing Co., and for the last ten years at GE in all phases of jet engine manufacturing and testing. . . . He has been a senior member, ASQC, for 12 years . . .

Peter F. Koets

BIRMINGHAM . . . Nov. 11, Dr. Howard S. Bryant "Statistical Applications in Relation to the Textile Industry" . . . Considerable interest in methods of optimizing company profits . . .

A. E. Raeuber

BOSTON . . . November meeting, J. Y. McClure, president, ASQC, explained some of the steps being considered to improve ASQC at the National level. Also presented "Tracking Quality Costs" . . . We feel he saw a vigorous and progressive section in action . . .

A ten week "Thinking Tools for Engineers" series starts in late February. Len Seder and Dorian Shainin will put the tools of the QC engineer into a presentation of value to any and all branches of engineering.

H. L. Keefe

BUFFALO . . . Nov. 28, Park Hotel, Lockport, N. Y. Claude V. Hawk, director of reliability, Harrison Radiator Division, GMC, Lockport, N. Y., "The Reliability Concept and Techniques of Application" . . . U.S. Naval Academy graduate, Masters degree in marine engineering from MIT, retired Navy Captain . . . Started at Harrison in 1957 as assistant chief engineer and assumed present duties in August, 1959 . . . .

According to Mr. Hawk, reliability is now measurable and can be stated in mathematical terms. For the first time, it is both a qualitative and a quantitative concept. It has been so successful that the military is spreading it to all elements of missile systems, and to aircraft and other weapons systems.

Industry is making even broader applications; major companies have extensive programs. Reliability is becoming as important a criterion as efficiency, speed, accuracy, or other performance factors, not only in consumer products, but in capital goods as well.

Irving Gordon

CHATTANOOGA . . . Nov. 8, meeting pre-empted by some really wild statistical guesswork, but Bill Davenport brought things back down to earth the next week with the last of our series on basic QC, entitled "Significance Tests" . . .

John L. Rose, Jr.

Highlight of the Cleveland section's All Day Conference on QC and Reliability Nov. 18, was a talk by Dr. Donald P. Eckman, left, on "Systems Research and Reliability—U.S. vs. Russia." The Conference included talks by Dr. Fred C. Leone, upper right, and Richard S. Bingham, Jr., center.

CHICAGO . . . December meeting, Furniture Club of America, ASQC Executive Director A. W. Wortham, manager of planning and management systems, Texas Instruments, Inc., with "Management Views on Experimental Design" . . .

Jan. 31, advanced course on statistical principles, University of Illinois, Navy Pier, see Clinics, Conferences, and Courses, page 55, this issue.

Feb. 8, 6:30 p.m., Mahogany Room, Furniture Club of America, 666 North Lake Shore Drive, Dr. Hodge, IBM, "Data Processing Machines"

John Dittrich

CLEVELAND . . . Nov. 18, All Day Conference on QC and Reliability, Hotel Pick Carter—218 in attendance—largest turnout in the past seven years . . . Conference highlight—talk by Dr. Donald P. Eckman, head of Systems Engineering Department, Case Institute of Technology, on "Systems Research and Reliability—U.S. vs Russia" really opened a lot of eyes . . . Expect a bigger and better conference next year . . .

Feb. 3, Cleveland Engineering and Scientific Center, W. R. Feightinger, Bureau of Naval Weapons, Washington, D. C., with "Value Analysis" . . . Also, timely topic, subject to be announced, at 5:30 p.m. . . .

Mar. 7, Spring education program, Western Reserve University . . . "Industrial Sampling Plans" and "Fundamentals of Correlation" courses . . . See Clinics, Conferences, and Courses, page 55, this issue . . .

Howard O. Schmidt

COLUMBUS . . . Nov. 16, meeting held at Kimble Glass Co., Division of Owens-Illinois . . . J. N. Linnerooth, QC manager, Tape Division, Minnesota Mining & Manufacturing Co., St. Paul, Minn., with "The Technical Management of QC" . . .

Feb. 15, 8 p.m., meeting at Jeffrey Manufacturing Co. . . . A. L. Phillips, assistant superintendent of inspection, Western Electric Co., Hawthorne Works, Chicago, Ill., with "Some QC Methods and Charts that Work" . . . The speaker has been associated with manufacturing processes as a product engineer and QC specialist and has a wide range of experience to draw upon . . .

George E. Arris

CORNING-ELMIRA . . . November meeting, Hickory House, Horseheads, N. Y., E. A. Reynolds, QC Consultant, Ligonier, Pa., with "Modern Inspection Techniques" . . . Traced the history of inspection from the earliest types of QC to the automatic systems of inspection . . . Mr. Reynolds emphasized new methods of inspection, including fluoroscopy, ultrasonics, eddy current tests, and other methods . . .

The second speaker, Ross S. Peterson, Magnaflux Corp., gave an illustrated tank on new types of inspection machines, from one that could be hand-carried to one so large it had to be shipped on a railroad flatcar . . .

Feb. 14, Hickory House, Horseheads, N. Y., Leon Peao, production superintendent, Corning Glass Works Television Tube Manufacturing Plant, with "Why Quality Control?" . . .

Richard J. Gibson

DALLAS-FORT WORTH . . . Nov. 17, joint meeting with Waco section . . . 41.2 percent of Waco section members made the 175 mile round trip to attend . . . This was an exceptionally good attendance considering the distance traveled . . . In all, 68 members and guests met at Circle C Steakhouse to hear a double-barreled program . . . D. B. Tallon, junior past chairman and District 14 representative, gave a 20 minute talk on "Why Saddoris" followed by Jim Coburn, Missiles and Space Division, Lockheed Aircraft Corp., with "Ten Years in QC! Where have We Been and Where are We Going?" . . . Mr. Coburn closed his talk with a color and sound movie of the launching of Polaris Missiles from a submarine . . .

R. R. Massegee

HAMILTON-MIDDLETOWN . . . Feb. 15, 6:30 p.m., Eaton Manor, Hamilton, Ohio, Raymond Malmeister and Mrs. Mary Hoskins will discuss "Inspection Procedures and Problems" emphasizing that if our procedures or tools of inspection are inadequate or faulty,

EMPLOYEE COOPERATION

in meeting your Quality Objectives can be accelerated by

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(See page 43)

statistical analysis, especially those derived from samples, are at least inadequate and may also be greatly misleading . . .

Mr. Malmeister is manufacturing and quality manager, Sheffield Corp. Mrs. Hoskins, who will give the paper, is chief metrologist, Sheffield's Eli Whitney Metrology Laboratories. A graduate of the University of Pennsylvania, Mrs. Hoskins was with the Frankford Arsenal in Philadelphia for 13 years prior to coming to Sheffield more than five years ago. One of her special fields is interferometry.

Lon Ely

HARRISBURG . . . Nov. 2, Media Heights Country Club, Lancaster, Pa., Max Tall, manager, reliability and value engineering, RCA, Moorestown, N. J., spoke on "Reliability" . . . Showed slides of the radar early warning system at Thule AFB, Greenland . . . Stressed the importance of standardizing all the blueprints, gages, procedures and vendors inspection in order to achieve the reliability demanded by this gigantic project. Guests —A. L. Goldsmith, RCA, Moorestown, Fifth District representative; E. M. Yanis, BMEWS Transistor Coordinator, RCA, Moorestown, and the Hartford, Conn., section chairman, Kenneth Martin, Holo-Krome.

The first pre-meeting clinic was held before this dinner meeting with professionalism as its topic. G. G. Thomas was the moderator with D. J. Neiser, Sylvania, A. J. Krause, RCA, and H. C. Schaller, Hamilton, as panel members. They discussed the need for college trained statistical QC engineers, using statistical tools to sell management on QC techniques, procedures, audits, tests, reports, and review recommendations.

The need for self-improvement in the use of many of the statistical tools by the section members was encouraged by the three courses which have been sponsored by the section.

Mar. 1, plant tour, Armstrong Cork Co., Closure plant, with dinner at the Overlook Country Club . . . Dr. C. E. Noble, Kimberly Clark Co., Neenah, Wis., with "Administrative Applications of QC" . . . A good opportunity to acquaint oneself with the process of manufacturing bottle caps and plastic and cork closures . . .

Ann Englehart

All Illinois Conference Feb. 4

An All Illinois Conference will be held Saturday, Feb. 4, at Burrill Hall, University of Illinois, Urbana, Ill.

"What I Expect of a Quality Control System" will be discussed at 10 a.m. by W. B. Biship, Sr., general superintendent, manufacturing, A. E. Staley Co., Decatur, Ill., and Robert Boeke, production superintendent, Industrial Equipment Works, John Deere and Co., Moline, Ill.

Speaker for the luncheon at Latzer Hall, University YMCA, will be Professor K. J. Trigger, head of Industrial Engineering, University of Illinois.

Concurrent afternoon sessions begin at 1:30 p.m., with "QC Applications Applied to Consumer Products," by A. H. Benscoter, J. E. Griffin, and R. H. Johnson of the A. O. Smith Co., Permaglass Division, Kankakee, Ill., and "Vendor Rating," by J. F. Jeffery, QC supervisor, Caterpillar Tractor Co., Joliet, Ill.

At 2:45 p.m., "Applied Statistics in Farm Machinery Development," by Dr. W. C. Jacobs, professor of Biometry and Data Processing, University of Illinois, and "The Distribution of Products, Quotients, of Random Variables as Related to Tolerancing," by Dr. I. W. Burr, Professor of Mathematics and Statistics, Purdue University.

Session chairmen are C. J. Streib, Sundstrand Corp.; D. W. Gierke, National Cylinder Gas Co., Chicago, Ill., and G. J. Burt, Joliet Arsenal.

Contact Professor R. K. Newton, supervisor Engineering Extension Division of University Extension, 116 D Illini Hall, University of Illinois, Urbana, Ill.

Pictured at the November meeting of the Harrisburg section were (from the left) J. T. Skelton, Caterpillar Tractor, York, Pa.; H. A. Gross, RCA, Lancaster, Pa.; A. J. Goldsmith, RCA, Moorestown, N.J., Fifth District representative, and R. J. Donsen, Bearings Company of America, Lancaster, Pa.

HARTFORD . . . Nov. 1, plant tour, Pratt & Whitney Aircraft Division, including machine shop, assembly area, and test stands . . . Most dramatic feature produced when the afterburner was fired on the J-57 engine . . .

Feb. 14, 6:30 p.m., Hartford section will sponsor jointly with ASTME the DoALL Company "Story of the Cutting Edge" at Royal McBee Corp., Hartford, Conn.

Lawrence J. Sespaniak

UNIVERSITY OF IOWA . . . Nov. 18, Cedar Rapids, Ia., Mr. Shideler presented his views on the importance of initiating effective reports which will be useful to all levels of organization . . .

Section secretary M. F. Wilson, Collins Radio Co., announced that any members or guests desiring to assist in the formation of a Cedar Rapids sub-section should inform him of their interest.

E. B. Godsey

KANKAKEE-JOLIET . . . Nov. 9, Third Annual Management Night, Joliet Arsenal Officers' Club, Leslie Eichelberger, QC engineer, A. O. Smith, Milwaukee, Wis., spoke on "The Economics of QC" as applied at A. O. Smith Corp. . . . Here they applied "Pareto's Law" of mal-distribution as a basis of determining where to concentrate scrap and rework cost-reduction efforts . . . If a relatively small number of jobs cause a proportionately large percentage of the cost of poor quality, studies of these would produce the greatest returns per dollar of investigation costs . . .

Feb. 7, D'Amico's Restaurant, Joliet, Ill., Robert Banzhar, Ordinance Ammunition Command, will speak on Sampling.

John E. Rauworth

KANSAS CITY . . . Nov. 17, Vivian L. Crawford and M. R. Easterday with "Electronic Testing, Correlation, and Data Collection" . . . Session included actual operation of the equipment . . .

Feb. 16, 7 p.m., Lantern Restaurant, "Reliability" by J. M. Wiesen, Sandia Corp., Albuquerque, N. M. . . .

H. Afton Taylor

LEXINGTON . . . Nov. 17, plant tour, Parker Seal Co., description of the many sizes and uses of "O" rings by Bill Hamilton, QC chief, aided by Ed Reinsch, plant superintendent . . . As a bonus, the section received a membership application from Bill Hamilton!

Feb. 16, 7 p.m., Lexington Signal Depot "Evolutionary Operations" by B. A. Carpenter, Union Carbide Chemical Co., Charleston, W. Va.

J. C. Graff

LIMA . . . Nov. 8, joint dinner meeting with the Lima Technical Council at Lima Engine plant, Ford Motor Co. . . . "Machine Capability" by I. A. De Grote, manager analysis and inspection, Standards Department, Engine and Foundry Division, Ford Motor Company — a slide presentation to 134 members and guests.

Feb. 14, Annual Ladies' Night, Lima Club, Lima, Ohio . . . "Quality Control—How It Benefits Mr. and Mrs. America" by P. Caruso, QC superintendent, Lima Engine plant, Ford Motor Co. . . . A good chance to better understand your function in QC.

E. K. Anderson

LOS ANGELES . . . Nov. 22, Douglas Aircraft Co., Santa Monica, Calif., spotlight speaker—Leo A. Carter, vice president and general manager of the Santa Monica plant, Douglas Aircraft Co., with "The Reliability Challenge in a Changing Industry" . . . guest speaker—R. G. Paul, Douglas reliability assurance section . . . panel chairman — F. T. Wood, Douglas product reliability manager . . .

Feb. 2, Inspection Division meeting, "Inspection and Test Demands for Fabrication of Ballistic Missiles" by Commander R. W. Smiley, QC office, Polaris Special Projects office, Bureau of Weapons . . .

Feb. 22, Statler Hilton Hotel, Los Angeles, Calif., Second Annual Reliability Symposium, see Clinics, Conferences, and Courses, page 55, this issue . . . November issue Symposium announcement incorrectly showed the luncheon speaker as Robert O. Sprague, Hughes Aircraft Co., Tucson . . . Speaker will be Dr. R. C. Sprague, Sprague Electric Co., "Reliability or Price."

Steve Kozich

LOUISVILLE . . . Nov. 14, Jimmy Lynn's Restaurant, 31 members and 10 guests present . . . After a short business meeting, an informative educational capsule was presented by Ted Lantz . . . Guest speaker—E. G. Bianco, section member, with "Subjective Testing" . . .

Feb. 13, Ladies' Night, Monogram Hall, General Electric Co. . . . Tour of "Model Kitchen" exhibits followed by guest speaker Robert Gilliland, Klarer Products Company with "QC in the Meat and Food Industry" . . .

C. R. Ferguson

METROPOLITAN . . . Nov. 9, Roosevelt Field Sagamore Room, Garden City, L. I., 187 members and guests, "Solving Work-a-Day QC Problems" by Nick Pavachich, Long Island sub-section chairman, and Joe McGrady necessitated the last minute appointment of nine additional table co-chairmen or discussion leaders . . . Frank McGinnis, quality manager, Sperry Gyroscope Co., keynote speaker, got the ball rolling . . . The resulting spirited discussion required very little motivation by the assigned table co-chairmen . . . The closing summation by the keynote speaker provided a fitting climax . . . It is considered significant that 30 guests expressed interest in joining ASQC . . . Effective follow-up may result in achievement of full section status for the surprisingly active Long Island Sub-section . . .

Nov. 28—Executive Committee Meeting highlights — Bill Frey, section chairman, went out on the limb by volunteering to have the 1963 Mid-Atlantic Conference run by the Metropolitan section in New York City . . . E. C. Torkelson's preliminary review of the section's financial status indicates "in-control" and in the black. John Grano's control chart on membership indicates the magic "1000" is possible in 1961 . . .

Feb. 4, All Day Chemical Division Conference—"Sam-

6th ASQC Workshop-Seminar

MANAGEMENT OF QUALITY CONTROL

April 6-7-8, 1961

Hotel Roosevelt, New York

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For whom is the program planned? For present and prospective Quality Managers. It is expected that the applicant will have reasonable familiarity with such standard texts as Grant, Feigenbaum, and Juran. To benefit properly from the seminar, the applicant should have a minimum of several years experience with major responsibility for quality.

Registrants will be sent study materials and case studies prior to the conference. Registration is limited to 75 persons and is complete only on receipt of the registration fee of $125 for non-members, $100 for members, which includes the cost of three luncheons.

Your Registration will be acknowledged. A room reservation card for the Hotel Roosevelt will be enclosed with the acknowledgment.

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Paul C. Clifford, Director

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Address .....

City.....**Zone No.**....**State**.....

NOTE: Additional registrations may be made by attaching a list to this coupon. Please include necessary information for each registrant.

pling of Ideas in Statistics," "Computer Applications," and "Experimental Designs" at Seton Hall University, South Orange, N.J.

Feb. 23, 6:30 p.m., dinner meeting, Hotel Shelburne, New York City, joint meeting with IRE Professional Group on Reliability and QC, topic—"Prediction of Reliability" . . . A lively discussion is expected with respect to Quality Control's role in the verification, assessment, and assignment of required quality levels in order to achieve optimum predicted reliability . . . At least two experts in the field of reliability will discuss the latest requirements . . .

S. G. Orban

MEXICO CITY . . . Dec. 7, a dinner and business session . . . Our guest of honor the honorable administrative secretary, ASQC, William P. Youngclaus . . . This was the last meeting of 1960 . . .

In preparation is a new course in basic QC to be held during the second and third weeks of February. The section has instituted a series of courses for the benefit of all the industrial plants in the area. These courses take place during the spring, summer and fall.

Domingo M. López

MID-HUDSON . . . November meeting, "Why Quality Engineering" with F. J. Sindelar, quality manager, Poughkeepsie plant, IBM, as panel moderator . . .

Feb. 7, workshop meeting on "Who Has Responsibility for Quality Improvement" with H. L. Mirick as coordinator . . .

J. Crowley, membership chairman, is making an all-out effort to put our membership at an all time high. Plans are underway to interest more Mid-Hudson industries in the work of the Society.

E. L. Leadbitter

MILWAUKEE . . . Nov. 18, a "star-studded" evening for the Milwaukee section at the Milwaukee Inn . . . After attending an all day ASQC Board of Directors meeting, many of the ASQC National Officers remained in Milwaukee to honor our section with their presence at the regular monthly dinner meeting . . .

The dinner, enjoyed by 75 members and guests, was followed by an interesting philosophical talk on "Experimental Designs" presented by Dr. A. W. Wortham, Texas Instruments, Inc., who is also one of the Society officers. He discussed the importance of emphasizing the complete experiment and its purpose, as more often than not experimenters become so engrossed in theory and the analysis that these objectives are overlooked. We in the field of statistics and QC should review the fundamentals and bases behind the experimental and scientific technology of experimentation to gain a broader perspective of the objectives, problems, analyses, and results of experiments.

Air gaging, including the techniques, types of gages, and area of application, was the topic of discussion at the education and training session held prior to the regular meeting. The thorough discussion of this matter enabled the 35 participants to greatly expand their knowledge of the gaging field.

Feb. 20, 8 p.m., Milwaukee Inn, panel discussion on Inspection . . .

Darrell G. Schroeder

MINNESOTA . . . November meeting, Holiday Inn, panel discussion on "Reliability" with Bob Meyers, Minneapolis Honeywell, as moderator . . . Three Remington Rand panelists, plus two Minneapolis Honeywell panelists were kept on their toes by questions from the audience . . . Subject was barely scratched since "QC Organizational Relation and Reliability" appeared to be a problem everyone wanted answers to; however, there is plenty of "meat" for further meetings on this subject.

New permanent name tags for members were very successful and were another aid to getting acquainted. Dinner was as good as ever and 60 members were there to enjoy it with an additional 15 to 20 arriving for the meeting.

Violet M. Rice

MONTREAL . . . Nov. 9, Ecole Polytechnique, University of Montreal campus, B. H. Lloyd, director of industrial economics, Price Waterhouse and Co., gave "An Interview on Quality Control" . . . Members had presented questions in advance . . . Selected topics from these questions were discussed . . . George Williams, TCA, moderated the discussions . . .

Feb. 8, Dominion Rubber Co., D. W. Guthrie of Dominion Rubber Co. Ltd., with "Common Sense Organization for Applied Industrial Statistical Quality Control" . . .

Mar. 8, Ecole Polytechnique, joint meeting with IRE, A. B. Oxley, Canadair Ltd., Montreal, with "The Mechanics of Reliability" . . .

T. F. Waterston

MUNCIE . . . Nov. 11, Muncie Section Night, interesting QC talks by our members . . .

Co-chairmen for the Ladies' Night program appointed by Richard Dix, section chairman, are G. W. Grile and Robert Dawson, Warner Gear Division, Borg Warner.

Feb. 16, Pine Shelf Room, Ball State Teachers' College Student Center, "How You Can Make a Multi-Plant QC Program Work" by H. O. Hehner, Monsanto Chemical Co., St. Louis, Mo. . .

C. B. Johnson

GREATER MUSKEGON . . . Nov. 10, Doo Drop Inn, family style chicken and beef dinner enjoyed by 45 members and guests . . . Topic—"QC at the A. O. Smith Corporation," by Reginald Hislop, QC director, A. O. Smith Corp., Milwaukee, Wis. . . . Several pictures were taken for our scrapbook . . .

Feb. 9, Annual Ladies Night, Black Angus Restaurant . . . guest speaker—Charles Anderson, Davenport Institute, Grand Rapids, Mich. . . .

Mar. 9, Annual Social Mixer, Mona Lake Boat Club—cards and pool will take over in place of a speaker.

W. A. Hume

Correction to 1960-61 Board of Directors

Frederick C. Hartwell was omitted from the listing of Directors on page 31, August issue, *IQC*. Mr. Hartwell is completing the unexpired term of Warren R. Purcell, director of quality control, Raytheon Co., Newton, Mass. Mr. Purcell resigned as Director, District 1, when he was elected vice president in charge of technical services, ASQC.

Frederick C. Hartwell
QC Coordinator
Smith Paper Division
Peter J. Schweitzer, Inc.
Lee, Mass.

December Issue Corrections

In "The Experiment, the Design, the Analysis," by Charles R. Hicks, December, 1960, issue, *IQC*, the error term in the analysis of variance is in error. At the top of the first column, page 19, the error term should read 12 and not 8, and the degrees of freedom should add up to 24, not 20.

In the same issue, page 30, ASQC News, Freemon is the correct spelling of Stanley Freemon, secretary of the Mansfield, Ohio, ASQC section. While this issue was in preparation, Egon Loeckel resigned as section treasurer. The new section treasurer is James R. Gatchell, Timken Roller Bearing Co., Bucyrus, Ohio.

In the same issue, Electronics Division Luncheon item, page 33, Alexander Sternberg should have been identified as a reliability engineer with General Electric Co., Philadelphia, Pa. Mr. Sternberg was formerly with Sonotone Corp.

At a recent technical session of the Philadelphia section, Glenn Johnson, Management Systems Consulting Division, Jonkers Business Machines, Inc., presented "Quality Control Exception Reporting."

NORTHEAST TENNESSEE . . . Nov. 10, Hotel General Shelby, Bristol, Tenn. . . . Pre-meeting QC Clinic on "QC and its Relation to the Industrial Enterprise," by F. R. Tretler, QC manager, Sperry Farragut Co. . . . Guest speaker—H. O. Hehner, QC manager, Organic Chemicals Division, St. Louis, Mo., on "How You Can Make a Multi-Plant QC Program Work" . . . Talk well received by members since many members in the area are employed by multi-plant corporations . . . Attendance—31 members and 31 guests . . .

Mike Gomez

OKLAHOMA CITY . . . November meeting, Uptown Cafeteria, ten guests and prospective members heard Dr. Leroy Folks, Texas Instruments, Inc., speak on "Experimental Errors" . . .

Feb. 14, Perry's Cafeteria, "Introduction to Quality Control" by Orde R. Weaver, Phillips Chemical Co.

B. J. Carson

OMAHA-LINCOLN . . . Feb. 10, Steak House, Omaha, Nebr., "Measurements and Standards," by Paul E. Smith, manager, industrial products division, Goodyear Tire & Rubber Co., Lincoln, Nebr., . . . Mr. Smith just returned from an International Meeting on Measurements and Standards in Paris, France, and will be an International Representative again next year . . .

T. C. Anker

PARKERSBURG . . . Nov. 16, Frank Caplan, QC manager, Westinghouse Corp., Blairsville, Pa., with "Incoming Inspection and Vendor Relations" . . . A short movie preceded the talk . . .

Feb. 15, 7:30 p.m., Marietta College, "Statistical Decision Making" by Dr. G. W. McElrath, University of Minnesota, St. Paul, Minn.

Robert R. Stewart

PENSACOLA-MOBILE . . . Nov. 10, plant tour of the Chemstrand Corp., Pensacola, Fla. . . . Opening remarks by J. R. Morten, QC superintendent . . . Messrs. Perry and Hussey described the functions and methods of operation of the Intermediate and Yarn Plants prior to the tour . . . We are grateful for the opportunity to view the complete operation of producing nylon . . .

Feb. 16, 6:30 p.m., Holiday Inn, Pensacola, Fla., "A QC Program that Management Can Use," by D. B. Tallon, QC supervisor, Convair . . . Sixteen of Mr. Tallon's 18 years in QC have been with Convair . . . He has participated in the development and administration of control functions including vendor quality control and evaluation, repetitive and corrective action, statistical QC and performance auditing, material review, procedures, and specification conformance . . . He is a past chairman and training director of the Dallas-Fort Worth section, District 14 representative, and a graduate of Texas Christian University . . .

Walter D. Nencka

PHILADELPHIA . . . Nov. 17, Sydney E. Longmaid, president of Esterbrook Pen Co., delivered an excellent talk on "Quality—the Consumer's View of It" . . . Offered basic principles on how the consumer knows what he wants and how important it is to the consumer that the item works properly . . .

Two technical sessions—"Quality Assurance Procedures in U.S. Army Signal Supply Agency" by Arnold Dodds and "Everyday Problems in QC" by Reginald Johnson—were both very informative and some interesting views and comments were exchanged during the sessions. Both speakers are Philadelphia section members.

Extra activity for this reporting period was a joint meeting of the Philadelphia section with MCTSA Dec. 1 at the Philadelphia QM Center. A. Mall, chairman of the education committee, has been doing a great job coordinating these Textile Division meetings. Judging by the enthusiastic turnouts, more will be planned for the future.

Albert G. Dettore

PITTSBURGH . . . Nov. 22, Dr. Cecil C. Craig, University of Michigan, gave an outstanding talk on "What Is Quality Control?" . . . Presented a good statement of what a professional quality control man should be competent to do; and further, he outlined the requirements and understanding of basic principles which should be acquired to make a professional man something of an egghead in his own field and not merely a technician . . . Outlined not only "why" but also "how" the ASQC should come to grips with the kind of education a QC

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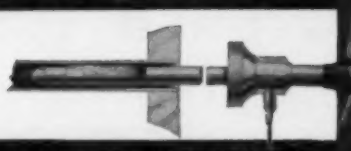

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man should have so that he can aspire to professional standing . . . Remarks were both stimulating and challenging to our members . . .

Feb. 28, Downtown YWCA, Kenneth H. Kramer, Applied Research Laboratories, U.S. Steel, with "Applications of Multiple Regression Analysis" . . . Several members assure us that we will attain an interesting insight into the utilization of regression techniques . . .

Chester R. Smith

PITTSFIELD . . . Nov. 16, a historic date for the Pittsfield section; on that night, our section threw caution to the wind and turned the group of peace loving citizens into gambling monsters . . . The scene— the roaring twenties complete with roulette wheels, chuck-a-luck, and a modern invention called the sampling box . . . Occasion—"Monte Carlo Night" or "Fun With Statistics" . . . Termed a very big success . . . Social hour followed by two hours of old fashioned gambling (with play money) followed by a buffet lunch and entertainment by Mr. and Mrs. Douglas Slingerland . . . At 11 p.m. the clock was turned ahead 40 years and the ladies and gentlemen returned to 1960—and home to release the babysitter after a very enjoyable evening . . .

Howard J. Greenslet

RHODE ISLAND . . . Nov. 17, a pre-meeting dinner was held for our speaker, Charles W. Carter, Industrial Management Consultant . . . One of a series of such dinners planned for the balance of the year so our members may become acquainted with the speaker prior to the formal meeting . . . Serve to establish a rapport between the speaker and his respective audience as well as for us to become better acquainted with the speaker himself . . . Mr. Carter's topic—"Product and Process Improvement through Statistical Engineering" . . .

Feb. 16, Warren R. Purcell, Raytheon Corp., with "Who Controls Quality and How?" . . . Students participating in our 15th week in the advanced QC course have been invited to attend this meeting . . .

Paul K. Moffat

ROCHESTER . . . Feb. 21, 6:30 p.m., Chamber of Commerce Bldg., joint meeting with the reliability sub-group . . . Topic—"Reliability Programs for Commercial Products" by Romeyn Everdell, Rath and Strong, Boston, Mass. . . . Members who cannot attend the dinner should still try to attend the meeting . . .

Mar. 28, 17th Annual QC Clinic, University of Rochester, Rochester, N. Y. . . . Twenty papers by leaders in QC and statistical work as well as a panel on Evolutionary Operations . . . This yearly affair always attended by some 1,000 persons . . .

Al Rickmers

SACRAMENTO . . . November meeting—our first Ladies' Night, a tremendous success . . . Speaker—Mr. Hirsch, Golden Nugget Casino, Las Vegas, Nev.

M. Walker

ST. CHARLES . . . Nov. 15, plant tour, Chicago Rawhide Co., dinner in plant cafeteria, program by QC department under the direction of Ralph Von Osinski . . .

February meeting—an afternoon seminar on Vendor Certification, an after dinner program with a slide lecture on "Reliability Studies" by Ellis Elder, QC manager, Admiral Corp., Harvard, Ill.

An all-day workshop is being planned for April. This will be conducted by section members.

Ellis Elder

ST. LOUIS . . . Nov. 19, Ray Primmer, "Setting Up a Quality Control Inspection System" . . . Attended by 43 members . . . Mr. Primmer was accompanied to St. Louis by Jack Lancaster, a former member of the St. Louis section, currently chairman of the Los Angeles section . . .

Feb. 16, the first of ten weekly sessions of the Intermediate Training Course will be presented by the section at the Sheraton-Jefferson Hotel, St. Louis, Mo. . . .

Feb. 17, 8 p.m., Golden Fried Chicken Loaf Restaurant, "Selling Quality Control," by Burr Stanton, General Electric Co., Louisville, Ky.

W. W. Paris

ST. PETERSBURG-TAMPA . . . Nov. 14, 65 members and guests . . . J. B. Williams, vice president of engineering, Electronic Communications, Inc., expressed his philosophy on the controversial subject "The Interrelation of Design, Reliability, and Quality Control" . . . Informative and most inspiring . . .

Nov. 28, executive council meeting at the home of Fred E. Steele, section chairman . . . Plans discussed for an additional section program consisting of a guided tour of one of the local electronic manufacturing concerns . . . Final arrangements to be announced at a forthcoming meeting . . .

Feb. 13, Morrison's Imperial House, "Human Factors in Space Age Conflict" by Dr. R. A. Ibison, Electronic Communications, Inc. . . .

Harold L. Goldberg

SAN ANTONIO . . . November meeting, 46 members and guests, "What QC Has Achieved in the Past 10 Years: Where Do We Go From Here?" by J. L. Coburn, manager of requirements and controls, Polaris Missile System, Lockheed Aircraft Corp. . . . His talk was supplemented with a movie on "Launching of a Polaris Missile from a Submarine" . . . D. B. Tallon, District 14 representative, accompanied Mr. Coburn on this tour and gave a slide presentation of National Headquarters along with slides concerning the merits of the Saddoris Award Program . . . This was an exceptional meeting and all in attendance were well pleased with this type of program . . .

R. W. Worrick

SANTA MARIA-VANDENBERG . . . Feb. 21, Andersen's Restaurant, Buellton, Calif., Robert T. (Pea Soup) Andersen with "The Pea Factor in Quality Control" . . .

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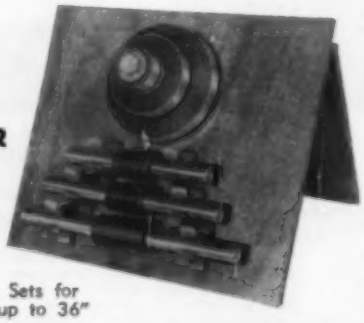

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Mar. 21, Santa Maria Club, Santa Maria, Calif., program sponsored by the Vandenberg AFB, AMCQC section . . .

T. L. (Tom) Russell, the 1959-60 section chairman, was transferred from Vandenberg AFB, Lockheed Missiles and Space Division, to the LMSD Polaris program at Sunnyvale, Calif. Tom played a very important role in getting this section organized and we regret his transfer.

E. P. Sullivan

SAN DIEGO . . . Nov. 14, Sands Hotel . . . Entertaining as well as educational . . . We're all shoppers at heart and are most anxious to have the "know-how" — whether shopping for quality in meats, canned goods, or woolens . . . Guest speaker Mrs. Helen E. Nelson, Consumer Counsel Governor's Office, State of California . . . The Counsel makes recommendations to the legislature in an advisory capacity, such as checking on pricing practices and setting quality standards for various products . . . 155 members and guests, including 30 ladies . . .

Feb. 13, L. E. Cole and W. G. Hubbell, Ryan Aeronautical Co., with "Modern Laboratory Practices for Accomplishing QC and Process Control Requirements" . . .

L. I. Fredrickson

SAN FRANCISCO . . . Nov. 14, Guy G. Parkin, Minnesota Mining and Manufacturing Co., with a method of applying QC techniques to sales forecasting which has achieved outstanding savings for his company . . . The method of analysis was shown to be equally applicable in the non-related fields of waste control, personnel efficiency, non-productive machine time, control of complaints, absenteeism, and others . . .

Feb. 13, 7 p.m., Cottage, Oakland, Calif., joint meeting with the Institute of Food Technologists, "Applications of QC to California Code for Fill Weights" by Bill Kirlin, Bureau of Weights and Measures, State of California . . . Expect a large turnout because of the interest in food container weight control by both groups . . .

M. R. Hubbard

SEATTLE . . . Nov. 15, final session of a three-meeting series on QC applied to aircraft . . . Speaker — E. L. (Andy) Andrews, chief ground service training, United Air Lines . . . Two previous meetings were "Quality Problems in Producing Commercial Jet Transports" and a plant tour of the Boeing Transport Division . . . Mr. Andrew's talk covered quality problems of operating airlines involved in providing top airline service. He brought with him 30 years experience in operating commercial jet air transport . . .

D. C. Lillis

SOUTH TEXAS . . . November meeting, J. L. Coburn, Lockheed Aircraft Corp., presented a very timely pep talk in addition to showing us a fine movie of the Polaris Missile in action . . . D. B. Tallon, District 14 representative, brought us up to date on the Saddoris Award and Society news . . .

Del Mar College, Corpus Christi, Texas, is offering for the third year three pertinent graduate courses for those who wish to learn engineering statistics. A. F. (Bert) Masters is the instructor . . .

Ed Franklin

SOUTHERN CONNECTICUT . . . Nov. 9, "A Contractor Prepares a Military Specification" by Herbert B. Epstein, Chance Vought Aircraft . . .

When the Navy Bureau of Ordnance was required to develop an operational fleet ballistic missile by 1960, the Special Projects Office awarded a contract to Chance Vought to develop contractor quality and reliability standards for the Polaris program. Mr. Epstein discussed the approach used and the problems encountered by Chance Vought in the preparation of these specifications.

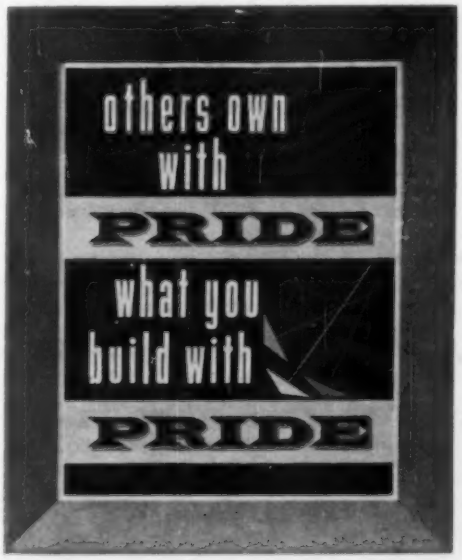
Feb. 8, a large turnout is anticipated for the section's Annual Ladies' Night meeting at the Colonial Steak House, Ridgefield, Conn. . . . A Revlon Company representative will talk on "QC in the Cosmetics Industry," and will present some practical "Do's" and "Don'ts" of modern makeup . . .

Robert E. Kleid

SYRACUSE . . . Nov. 17, joint meeting with Standards Engineering Society at the Birches Restaurant . . . "Facing Today's Quality Spiral" by James L. Harris, quality manager, Standard Pressed Steel, Jenkintown, Pa. . . .

Nov. 19, section chairman Klare Teegarden participated as a judge in a Mathematics Symposium at the Jamesville-DeWitt high school, an annual event sponsored by the Onondaga County Mathematics Teachers Association and the Manufacturers' Association of Syracuse . . . Presentations by students from the seventh through twelfth grades are judged by representatives from industries, schools, and universities in the Syracuse area . . . Indeed impressive to see the high level of competence which these students display in mathematical subjects ranging from "Base 5," "Matrices," and "From Circular Motion to Simple Harmonic Motion," in seventh grade to "Statistics in Quality Control," "Vectors," "Conic Sections," and "Probability," in the twelfth grade. Symposiums of this nature definitely create a healthy environment for students and any promotion by ASQC sections throughout the country would be rewarding . . . worthwhile . . .

The Technical Societies Council of Greater Syracuse is an organizational of 30 technical and professional societies comprising more than 5,000 technical and professional people. The objectives of the council are: to further public welfare wherever technical and engineering knowledge and experience are involved; to promote cooperation among technical and engineering societies



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(See page 49)

of Central New York; to consider and act upon matters of mutual concern to the engineering and allied technical professions. A major annual activity is a Symposium held during Engineer's Week. The event is co-sponsored with the Professional Engineering Society and includes prominent speakers with timely subjects and a banquet.

Each year the Syracuse section refrains from its February meeting so that all members may participate in or attend this annual Engineering Symposium.

Lee E. Huyler, Jr.

TENNESSEE . . . November meeting, H. A. Lasater, Union Carbide Nuclear Co., presented the third in a series of quality control training sessions . . . Purpose—to familiarize area industries in the use of QC . . . Following this session, Orval L. Buckner, Magnavox Corp., presented "QC in Hi-Fi Manufacture" . . . A Movie entitled "Acceptance Sampling" was also shown . . .

Feb. 11, "Statistics As Applied to the Drug Industry" by Osberne Carpenter . . .

J. P. Reavis

TOLEDO . . . Nov. 3, Management and Guest Night, Electric Autolite Company panel from Fostoria, Ohio, was very capably moderated by our past Toledo section chairman, Fred D. Reardon, plant superintendent . . .

Jan. 5, dinner meeting at EST Club Rooms with King E. Forry, senior systems analyst, Owens-Illinois Co., as speaker. His topic—"IBM 650 Computer and Its Applications in QC" . . . A discussion will be moderated by Theodore R. Meyer, QC director, Kimble Glass Co.

Feb. 2, plant tour, Whirlpool Corp., Clyde, Ohio, with our member, Stephen J. Horvath, plant QC manager, as moderator . . .

Carwin L. Elwick

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TORONTO . . . Feb. 22, 8 p.m., CGE, election of 1961-62 officers . . .

Mar. 11, All Day Forum, Hart House, University of Toronto . . .

George Culver

TUCSON . . . You have often heard the statement "No News is Good News" . . . Especially true about the Tucson section—although nothing has been published so far this season concerning activities in this area, good things have been happening . . .

Sept. 29, first dinner meeting of the season, "Kitt Peak National Observatory and the Orbiting Telescope" by Russell A. Niday, systems manager, Space Division, Kitt Peak National Observatory, proclaimed as one of the best talks ever to be delivered in this area . . .

Fred Ennerson, professional development chairman, gave a short enthusiastic report on his trip to the ASQC Convention in San Francisco, Calif., last May . . .

Oct. 26, "Nuclear Energy Goes to Work" by J. L. Bernick, quality project manager, Martin Co., Baltimore, Md., also tops . . . All meetings have been well attended and interest in ASQC in the Tucson area has been gratifying . . .

Hughie W. Shea

WACO . . . November, joint meeting hosted by the Dallas-Fort Worth section . . . thoroughly enjoyed by Waco section members . . . movie of Polaris Missile launching from a Submarine shown by J. L. Coburn, Lockheed Aircraft and Missiles Division . . .

Donald H. Barrett

WASHINGTON, D.C. . . . Feb. 15, Dr. Morris H. Hansen, Bureau of the Census, Department of Commerce, Washington, D. C., with "QC in the 1960 Census" . . . Presentation at the General Services Administration Auditorium, "F" St., between 18th and 19th St., N.W., at 8 p.m. . . .

The section is sponsoring the formation of student sections at local universities, including George Washington, Georgetown, Catholic, Maryland, and Howard, under the general guidance of Dr. Chester McCall, section vice chairman. Our training session at Georgetown University was completed Dec. 6. Attendance was excellent with 65 students enrolled.

In order to meet more adequately the needs of our members, we have initiated an expanded monthly news letter that will contain section information, announcements, job openings, and new books and articles of interest to members.

The Washington Operation Research Council has been formally organized in this area to promote the discussion and application of OR techniques. Several ASQC members are taking active roles in this organization.

Eugene Tucker

WESTERN MASSACHUSETTS . . . Nov. 8, "A Practical Application of Statistical QC" by A. P. Stergion, QC manager, Corning Glass Works, Corning, N.Y. . . . Most interesting and successful, and very well attended in spite of the keen competition from the constant and thorough coverage of election results . . .

Feb. 2, following completion of the course "Introduction to QC" an intermediate course will be co-sponsored by the section and the Massachusetts University Extension, as was the previous course . . . It is expected that it will be a credit course of 15 week duration, and will be conducted by Hyman Edelstein, QC engineer, Stanley Home Products, and Stanley E. Lezinski, QC superintendent, Bigelow-Sanford, Inc., both section members, at Holyoke, Mass., high school . . .

Feb. 14, 6:30 p.m., Shelton Hotel, Springfield, Mass., "Assembly of Complex Assemblies" by A. E. Aubin, QC manager, Underwood Corp., Hartford, Conn.

Alan J. Donnelly

WINDSOR . . . Congratulations are in order for Ken Crew and his associates on the excellent all day Forum (See Significant Difference for the details) at the Cleary Auditorium and Convention Hall, Nov. 26.

Bill Moggridge, former Windsor section member, was in town as a panelist at the Forum.

A. J. Hewitt

WORCESTER . . . Nov. 17, Nick's Grill, panel discussion by section members Francis Olson, Robert W. Mason, Nasim David, and Daniel J. Burda . . . Panel moderator —Frederick K. Nash, section chairman . . . Panel members discussed machine capability, non-parametrics, and frequency distribution as encountered in their experience and operation of QC programs in their own plant . . . Management personnel from suburban industries attended the meeting . . .

Nov. 22, the executive committee met at South Works VFW to complete plans for an interesting and entertaining Ladies' Night for Feb. 16 at the Town and Country Restaurant . . . It will feature "Vi" and her accordion and a travelogue by Four Seasons Travel Agency . . .

This spring a basic QC course will be held at the Worcester Polytechnic Institute.

Daniel J. Burda

YOUNGSTOWN . . . Nov. 3, 76 members and guests filled two buses for a memorable trip through the plant of Fisher-Euclid Division General Motors Corp., Euclid, Ohio . . . The group was impressed with QC methods used in the manufacture of auto bodies . . . The group stopped at the Charter House, Cleveland, Ohio, for dinner preceding the plant tour . . .

Feb. 2, Jay O. Mack, U.S. Steel Corp., Fairless Works, Fairless, Pa., will speak on "Steel Mill Quality Control . . .

Mar. 2, Dale Cue, quality manager, Hoover Ball and Bearing Co., Ann Arbor, Mich., with "Some Frustrations and Difficulties in Applying the Total Quality Control Concept" . . .

Charles Wirebaugh

Significant Differences

. . . ALLENTOWN-BETHLEHEM — **Dick Zwickl,** our genial chairman, participated in the recent 1960 Middle Atlantic and Tenth Annual Aircraft and Missiles Division Conference at the Lord Baltimore Hotel, Baltimore, Md., as a moderator.

Don Snyder, Western Electric, Laureldale, Pa., spoke at a four hour seminar on reliability conducted at the Allentown plant, Western Electric Co., for the benefit of QC supervisors and engineering department chiefs and engineers.

Bob Tust, our assistant treasurer, is working on his master's degree at Rutgers • The State University, New Brunswick, N. J.

. . . CHICAGO—It's not too late to enroll for the advanced course in statistical principles which will begin Jan. 31, University of Illinois, Navy Pier. See Clinics, Conferences, and Courses, page 55, this issue.

Hubert N. Leipzig has been appointed QC manager by Culligan, Inc., international manufacturer of water softening and conditioning equipment.

Jonmore Dickason, vice president, Metal Control Laboratories, Los Angeles, Calif., will continue in the management of the firm's business activities. MTL was recently acquired by Magnaflux Corp., Chicago, Ill., a wholly owned subsidiary of General Mills, to effect a complete complement of integrated nondestructive, metallurgical, and physical testing facilities and skills. Metal Control Laboratories will be operated as a part of the Magnaflux organization, working closely with the present Magnaflux Materials Testing Laboratories at Los Angeles and Van Nuys, Calif.

. . . CLEVELAND—The section wishes a speedy recovery to **Dick DeGray.** As vice chairman of the program committee, Dick's enlightening introduction of the speaker was missed at the last meeting. We hope Dick will be back with us at the next meeting.

. . . COLUMBUS—**Robert S. Ickes,** department chief of quality control, Western Electric Co., Columbus plant, has been promoted to assistant supervisor, operating division, Western Electric Co., Allentown, Pa.

The section was very pleased to have **Keith L. Lewis,** District 8 representative, in attendance to furnish the latest information on district and national activities.

. . . CUMBERLAND—**William D. Kelley** has joined the Allegheny Instrument Company division of Textron Electronics, Inc., at its factory in Cumberland, Md.

. . . DALLAS-FORT WORTH—**M. R. Seldon,** Chance Vought, has been appointed as director to fill the vacancy created when **W. E. Smith** transferred to Aerojet General, Sacramento, Calif.

A few members of the Dallas-Fort Worth section must be setting some kind of record. For the last two months a group from U.S. Gypsum Co., Sweetwater, Texas, has made the 225 mile (one way) trip to attend the section meetings. Perhaps this makes up for some of the members who live just around the block who can't seem to attend.

. . . HAMILTON-MIDDLETOWN — Section chairman **Duwayne Carlson** called a meeting of the executive committee at the Hamilton YMCA on Nov. 30. Among other business, the educational program and the January Conference were thoroughly discussed and applications from four prospective members were accepted.

Bernie Bond has been transferred from the Middletown Aeronca plant to Aeronca's Alabama plant.

. . . UNIVERSITY OF IOWA—Professor **L. A. Knowler** is on leave of absence, serving as a consultant to the Bureau of the Census. For most of his leave he will be attached to the Foreign Operations Administration and

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SECTION CALENDAR (FEBRUARY 1 TO MARCH 10)

SECTION	DATE	PLACE	TIME	SUBJECT	SPEAKER
Akron-Canton	Feb. 16	Iacomini's	8:00 p.m.	Sampling Techniques for Management	Richard M. Cyert, Carnegie Institute of Technology
Albany	Feb. 2	Crossroads Restaurant	6:00	High Quality Through Quality in People	E. V. Grumman, Bullard Co., Fairfield, Conn.
	Mar. 2	Crossroads Restaurant	6:00	Ladies' Night, Control Charts for the Factory Can be Used in the Home	Nick Demos, General Electric Co.
Allentown-Bethlehem	Feb. 8	Hotel Traylor	7:00	Short Run QC	Miss Bonnie Small, Western Electric Co.
			8:00	Vendor-Consumer Relations	A. P. Stergion, Corning Glass Works
	Mar. 8	Hotel Abraham Lincoln	8:00	QC—The Seeing Eye of Production	R. G. Mitchell, International Latex Corp.
Baltimore	Feb. 21	To be announced	....	QC and Operations Research	Dr. F. E. Grubbs, Weapon Systems Laboratory, Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland
Battle Creek-Kalamazoo	Feb. 16	Oldsmobile Company	8:00	Outgoing Control of Quality and Customer Complaints	Curtis Williams, General Electric Co., Evandale, Ohio
Birmingham	Feb. 17	Tutwiler Hotel, Birmingham, Ala	6:30	Ladies' Night, Operations Research	W. G. Stanton, University of Alabama
Boston	Feb. 9	MIT Faculty Club	....	Specifications, People, Reliability	Louis J. Paddison, Sandia Corp.
				The Use of Statistics in a Filling Machine Capacity Study	Joseph MacLeod, Walter Baker Chocolate Co.
Merrimac Valley Sub-section	Feb. 2	To be announced	....	Evaluation of Contractors' QC Inspection Systems	Karl P. Sperber, Naval Ordnance, Corona, Calif.
	Mar. 2	To be announced	....	Quality Training	Bernard Goldsmith, Northeastern University
Boston	Mar. 9	MIT Faculty Club	....	Recruiting, Training, and Professional Development of QC Administrators and Engineers	Panel Discussion
Buffalo	Feb. 27	Red Lobster Inn, Kenmore, N.Y.	....	Joint meeting with ASA, Better Answers With Less Work	W. J. Youden, Bureau of Statistics, Washington, D.C.
Chattanooga	Feb. 13	To be announced	....	Joint meeting with Industrial Engineering Group, Traffic Control	Marble Hensley, City Traffic Engineer
Chicago	Feb. 8	Furniture Club of America	6:30	Data Processing Machines	Dr. Norman C. Hodge, IBM
Cleveland	Feb. 3	Cleveland Engineering and Scientific Center	7:45	Value Analysis	W. R. Feightinger, Bureau of Naval Weapons, Washington, D.C.
Columbus	Feb. 15	Jeffrey Manufacturing Co.	8:00	Some QC Methods and Charts that Work	A. L. Phillip, Western Electric Co., Hawthorne Works, Chicago, Ill.
Corning-Elmira	Feb. 14	Hickory House, Horseheads, N.Y.	7:00	Why Quality Control?	Leon Peao, Pressware Plant, Corning Glass Works, Corning, N.Y.
Dallas-Fort Worth	Feb. 22	Circle C. Steakhouse, Grand Prairie, Texas	7:00	Reliability of Guided Missile Systems	Harvy W. Fritz, AF Ballistic Missile Division, Los Angeles, Calif.
	Mar. 7	Western Hills Inn, Highway 183	7:00	Quality Control Management	J. M. Juran, Management Consultant, New York, N.Y.
Dayton	Mar. 4	Biltmore Hotel	9:00 a.m.	Fifth Dayton QC Conference	Various
Greater Muskegon	Feb. 9	Black Angus Restaurant	6:30 p.m.	212 Degree—The Magic of Enthusiasm	Charles Anderson, Davenport Institute, Grand Rapids, Mich.
	Mar. 9	Mona Lake Boat Club	6:30	Social mixer and shrimp dinner	.....
Hamilton-Middletown	Feb. 15	Eaton Manor, 1892 Dixie Highway, Hamilton, Ohio	6:30	Inspection Procedures and Problems	Raymond Malmeister and Mrs. Mary Hoskins
Harrisburg	Feb. 1	VFW, 617 W. Market St., York, Pa.	6:30	Election of Officers, Selling QC to Management	Panel discussion—Paul Rholf, Lambert-Hudnut, Lititz, moderator
	Mar. 1	Plant Tour, Armstrong Cork Co., Closure Plant	....	To be announced	To be announced
		Overlook Country Club	6:30	Administrative Applications of QC	Dr. C. E. Noble, Kimberly-Clark Corp., Neenah, Wis.
Hartford	Feb. 14	Royal McBee Corp.	6:30	Joint meeting with ASTME, The Story of the Cutting Edge	DoALL Co. presentation
State University of Iowa	Feb. 24	LeClair Hotel, Moline, Ill.	8:00	Process Controls in a Job Shop	Frank Caplan, Jr., Westinghouse Corp., Blairsville, Pa.
Kankakee-Joliet	Feb. 7	D'amico's Restaurant, Joliet, Ill.	6:30	Sampling	Robert Banzhaf, Ordnance Ammunition Command
	Mar. 7	Simoniz Co., Kankakee, Ill.	7:30	Plant tour	To be announced
Kansas City, Mo.	Feb. 16	Lantern Restaurant	7:00	Reliability	J. M. Wiesen, Sandia Corp., Albuquerque, N.M.
Lexington	Feb. 16	Lexington Signal Depot	7:00	Evolutionary Operations	B. A. Carpenter, Union Carbide Chemicals Co., Charleston, W. Va.
Lima	Feb. 14	Lima Club, Lima, Ohio	....	Ladies Night, QC—How It Benefits Mr. & Mrs. America	P. Caruso, Ford Motor Co., Lima, Ohio
Los Angeles	Feb. 2	To be announced	....	Inspection Division Meeting, Inspection and Test Demands for Fabrication of Ballistic Missiles	Commander R. W. Smiley, QC Officer, Polaris Special Projects Office, Bureau of Weapons
	Feb. 22	Statler Hilton Hotel	9:00 a.m.	Second Annual Reliability Symposium	Various
Louisville	Feb. 13	Monogram Hall, Appliance Park, General Electric Co.	....	Ladies' Night, QC in the Meat and Food Industry	Robert Gilliland, Klarer Produce Co.

Metropolitan	Feb. 4	Seton Hall, University, South Orange, N. J.	9:00 a.m.	All Day Chemical Conference—Sampling Ideas in Statistics, Computer Applications, and Experimental Designs	Various
	Feb. 23	Hotel Shelburne, New York, N.Y.	6:30 p.m.	Joint meeting with Professional Group on Reliability and QC of IRE, Predicition of Reliability	J. Y. McClure, Convair, Fort Worth, Texas, Moderator
Mid-Hudson	Feb. 7	Hotel DiPrima, Highland, N.Y.	8:00	Workshop—Who Has Responsibility for Quality Improvement?	Co-ordinator—H. L. Mirick
	Mar. 7	Hotel DiPrima, Highland, N.Y.	8:00	Measurements and Quality Costs	H. L. Freeman
Milwaukee	Feb. 20	Milwaukee Inn	8:00	Inspection	Panel discussion
Minnesota	Feb. 1	Holiday Inn	6:30	Ladies' Night: Talking Your Way Into Trouble	Prof. G. Shapiro, Speech Department, University of Minnesota
	Feb. 14	Lowry Hotel, St. Paul, Minn.	9:00 a.m.	One Day Clinic	Various
Montreal	Feb. 8	Dominion Rubber Co.	8:15 p.m.	Common Sense Organization for Applied Industrial Statistical Quality Control	D. W. Guthrie, Dominion Rubber Co., Ltd.
	Mar. 8	Ecole Polytechnique	8:15	Joint meeting with IRE, The Mechanics of Reliability	A. B. Oxley, Canadair, Ltd., Montreal
Muncie	Feb. 16	Pine Shelf Room, Student Center, Ball State Teachers' College	.....	How You Can Make a Multi-Plant QC Program Work	H. O. Hehner, Monsanto Chemical Co., St. Louis, Mo.
Northeast Tennessee	Feb. 14	Bristol, Tenn.	6:00	Determination of Instrument Accuracy	S. L. Carrell, Germanium Products, Texas Instruments, Dallas, Texas
Oklahoma City	Feb. 14	Perry's Cafeteria	6:00	Introduction to QC	Orde R. Weaver, Phillips Chemical Co.
Omaha-Lincoln	Feb. 10	Steak House, Omaha, Nebr.	6:30	To be announced	To be announced
Parkersburg	Feb. 15	Marietta College	7:30	Statistical Decision Making	Dr. G. W. McElrath, University of Minnesota
Pensacola-Mobile	Feb. 16	Holiday Inn, Pensacola, Fla.	6:30	A QC Program Management Can Use	D. B. Tallon, Convair
Philadelphia	Feb. 16	Germantown Cricket Club	6:15	QC in Steel Industry	Louis L. Mandich, Lukens Steel Co.
Pittsburgh	Feb. 28	Downtown YWCA	6:30	Applications of Multiple Regression Analysis	Kenneth H. Kramer, U.S. Steel, Applied Research Laboratories
Pittsfield	Feb. 15	To be announced	.....	Optimum Relationships—Quality Control and Purchasing	Panel discussion
	Mar. 5	To be announced	.....	Joint meeting with IRE, AIEE	To be announced
Rhode Island	Feb. 16	Engineering Society Bldg., Providence, R.I.	8:00	Who Controls Quality and How	Warren R. Purcell, Raytheon Corp.
Rochester	Feb. 21	Chamber of Commerce Bldg.	6:30	Joint meeting with Reliability Sub-group, Reliability Programs for Commercial Products	Romeyn Everdell, Rath and Strong, Boston, Mass.
St. Louis	Feb. 17	Golden Fried Chicken Loaf Restaurant	8:00	Selling QC	Burr Stanton, General Electric Co., Louisville, Ky.
St. Petersburg-Tampa	Feb. 13	Morrison's Imperial House	6:30	Human Factors in Space Age Conflict	Dr. R. A. Ibison, Electronic Communications, Inc.
San Antonio	Feb. 21	Granata Hotel		Nondestructive Testing	B. E. Justice, Convair, Fort Worth, Texas
San Diego	Feb. 13	Sands Hotel, Clairmont Mesa Blvd., Highway 395	7:00	Modern Laboratory Requirements for Accomplishing QC and Process Control Requirements	L. E. Cole, and W. G. Hubbell, Ryan Aeronautical Co.
San Francisco	Feb. 13	Cottage, Oakland	7:00	Application of SQC to California Code for Fill Weights	Bill Kirlin, Bureau of Weights and Measures, State of California
Santa Maria-Vandenberg	Feb. 21	Andersens Restaurant, Buellton, Calif.	6:30	The Pea Factor in QC	Robert T. (Pea Soup) Andersen
	Mar. 21	Santa Maria Club, Santa Maria, Calif.	6:30	Program by Vandenberg AFB, AMCQC Section	To be announced
Seattle	Feb. 14	Benjamin Franklin Hotel	7:30	Managements' Viewpoint of Quality Control	Panel discussion
South Texas	Feb. 18	To be announced	9:00 a.m.	All Day Conference	To be announced
Southern Connecticut	Feb. 8	Colonial Steak House, Ridgefield, Conn.	6:30 p.m.	QC in the Cosmetics Industry	The Revlon Co.
	Mar. 8	The Bryant Electric Co., Bridgeport, Conn.	6:30 p.m.	Purchasing and Quality	Paul Bussette, Burndy Corp., Norwalk, Conn.
Tennessee	Feb. 11	Knoxville, Tenn.	8:00	Statistics as Applied to the Drug Industry	Osberne Carpenter
Toledo	Feb. 2	Whirlpool Corp., Clyde, Ohio	7:00	Plant tour, QC in the Appliance Industry	Moderator—Stephen J. Horvath, QC Manager
	Mar. 2	EST Club Rooms, Toledo, Ohio	6:30	To be announced	To be announced
Toronto	Feb. 22	Canadian General Electric	8:00	Election of officers	.....
	Mar. 11	Hart House, University of Toronto	9:00 a.m.	All Day Forum	Various
Waco	Feb. 20	Leslie's Chicken Shack	6:30 p.m.	Nondestructive Testing	B. E. Justice, Convair Aircraft, Fort Worth, Texas
Washington, D.C.	Feb. 15	General Services Administration Auditorium	8:00	QC in the 1960 Census	Dr. Morris H. Hansen, Bureau of the Census, Department of Commerce, Washington, D.C.
Western Massachusetts	Feb. 14	Shelton Hotel, Springfield, Mass.	6:30	Assembly of Complex Assemblies	A. E. Aubin, Underwood Corp., Hartford, Conn.
Worcester	Feb. 16	Town and Country Restaurant, Sterling, Mass.	7:30	Ladies' Night, "Vi" and her accordion	Travelogue
Youngstown	Feb. 2	Astoria Cafe	6:30	Steel Mill QC	Jay O. Mack, U.S. Steel Corp., Fairless, Pa.
	Mar. 2	Astoria Cafe	6:30	Some Frustrations and Difficulties in Applying the Total QC Concept	Dale Cue, Hoover Ball and Bearing Co., Ann Arbor, Mich.

will be out of this country. Due to this leave of absence, he will not be able to conduct a fall course in QC at the University of Iowa. His address—Statistical QC Advisor, U.S. Consulate General, 5/1 Harrington St., Calcutta 16, India.

. . . KANSAS CITY—The section reports the following changes in personnel:

From Kansas City—**Jim Hopkins** to St. Paul, Minn.; **Jas. H. Wagner,** Salt Lake City, Utah; **Boyd Nusbaum,** Los Angeles, Calif.; **John Welch,** Anaheim, Calif.; **Ralph Starkes,** Joplin, Mo.; **Delbert H. Cull,** Plainsfield, N. J.; **Vincent Hwang,** Raleigh, N.C., and **Don W. Anthony,** Toledo, Ohio.

To Kansas City—Merle M. Irons, Alameda, N.M.

. . . LEXINGTON—**Archie Dedman,** section treasurer, has been teaching a course in supervisory development in the evening program at the Lafayette Vocational School.

Woodrow Waters, shop inspection foreman, Lexington Signal Depot, has accepted an overseas duty assignment. He will be chief of the electronic repair shop, USA General Depot, Saumer, France, for the next two years.

. . . METROPOLITAN — An excellent scrap book by **Morris Israel** will be on display at the annual dinner meeting, Shelburne Hotel, New York City, Feb. 23.

Orlando E. Panfile was among the 30 part-time lecturers who were honored Dec. 1 by the Newark Extension Center, Rutgers • The State University, for "loyal and faithful service." Mr. Panfile has been an instructor in introductory and intermediate QC since 1953. He is QC manager, Semi-Conductor Division, Tung-Sol Electric Co., East Orange, N. J.

. . . MID-HUDSON — **Frank J. Raskoski,** has been promoted to technical associate in the QC engineering group, Poughkeepsie plant, IBM. Mr. Raskoski joined IBM in 1951.

. . . MILWAUKEE—Our section welcomes **James Tierney** who has transferred from the Greater Detroit section. Jim is manager of quality assurance, Battery Division, Globe-Union, Inc.

. . . MINNESOTA—**Ray Toibonen,** Minnesota Mining & Manufacturing, has transferred from applied mathematics and statistics department to the tape quality department as a statistician. Hope you find QC a challenge and an interesting change, Roy.

Having our permanent meeting place, Holiday Inn, has made a "Significant Difference" in our turnout to meetings and a feeling of closeness as a group!

. . . MONTREAL—Professor **Roger Lessard** has been elected second vice-chairman of the Alumni Association of the University of Montreal.

Claude de Courval, Canadian Industries Ltd., is spending two months in England with the Imperial Chemical Industries. He was recently awarded a medal on water pollution studies.

. . . MUNCIE—At our meeting Nov. 11—Muncie Section Night—Carleton McCray, Chevrolet, Muncie plant, spoke instead of Richard Sowastsky. His topic—Problems of Forging Torsion Bars to Close Tolerances.

. . . GREATER MUSKEGON—Dr. **Eli Dee Compton,** research director, Eagle Ottowa Leather Co., Grand Haven, Mich., has taken a new position as group leader in charge of research at the Maumee Chemical Co., Toledo, Ohio.

. . . NORTHEAST TENNESSEE — The joint meeting with the American Statistical Association at Marion, Va., Nov. 19, was a marked success. Twenty-five persons attended the all day session and heard some interesting presentations by **K. J. Fraley, Boyd Harshbarger, Raymond C. Rhodes,** and **Hubert Hill.** Among those present from the section were Mr. Hill, past chairman, **Joe Johnston,** section chairman, and **Bill Morgan,** chairman elect.

A course in basic industrial statistics began in Bristol Nov. 7. The six week course met two nights a week and was open to all industrial workers in the area. It was sponsored by the section and State and City School Boards.

Plans are underway to present a graduate course in mathematical statistics for members in and around Bristol. The course will be presented by East Tennessee State College under the sponsorship of this section.

. . . PARKERSBURG—The section has been showing a short movie at the beginning of meetings this year. So far this has been met with approval.

. . . PHILADELPHIA—**John Saboe** has transferred to International Resistance Corporation at a QC engineer.

Jules Mehalek, general chairman, Philadelphia host committee, 15th Annual Convention and Exhibit, has announced two replacements. **Elizabeth G. Ross** is new registration chairman and **Len Henryson** is new district coordinator.

. . . RHODE ISLAND—**Joseph G. Kowalski,** section secretary, formerly QC engineer, Firestone Rubber and Latex Products Co., Fall River, Mass., is now QC manager, Cornell Dubilier Electric Corp., Providence, R.I.

. . . ROCHESTER — **Carl Jensen,** section junior past president, left Haloid Xerox Inc., to join General Electric Co., St. Petersburg, Fla.

. . . ST. PETERSBURG-TAMPA — Congratulations are in order for:

Dewitt C. Brown, manager of QC engineering, Pinellas Peninsula Plant, General Electric Co., on his election as District 15 representative, ASQC.

Harold Z. Snyder, project engineer, reliability engineering, Electronic Communications Inc., on his election as District 15 representative of Electronics Division, ASQC.

Henry P. Stadnik, QC supervisor, Electronic Communications Inc., on his appointment as staff engineer for quality assurance and control for the ECI portion of the new and vital ALRI (Airborne Long Range Input) program linking USAF's early warning system to SAGE, our Continental Defense Network.

. . . SAN DIEGO — **Russell DeLong,** from Convair-Astronautics to QC manager, Fluidgenics, San Diego area.

. . . SANTA MARIA-VANDENBERG — **T. L. (Tom) Russell,** last year's section chairman and our current program chairman, has been transferred from the Lockheed Missiles and Space Division quality assurance section, Vandenberg AFB, to the Polaris Reliability Engineering section at Sunnyvale, Calif. As you know,

John Hummer

The Harrisburg section and the Society wishes to extend its heartfelt sympathy to the family of John Hummer, Manheim, Pa., on his recent death Nov. 23.

Mr. Hummer was associated with the Fuller Co., Manheim, Pa., for 35 years. He was an active ASQC member and will be missed by the section.

Tom was the one who organized our section about a year ago. We will certainly miss his fine work in the section.

. . . SCRANTON-WILKES BARRE—**Charles H. Rubin,** formerly QC manager, W. L. Maxson Corp., Old Forge, Pa., is now QC manager, Nortronics, a division of Northrop Corp., Norwood, Mass.

. . . SOUTHERN CONNECTICUT — **Isadore Levine,** CBS Laboratories, was recently promoted to QC manager of the Laboratories.

. . . SYRACUSE—**Emanuel Davis** has been appointed QC manager, Rectifier Components Department, General Electric Co.

. . . TUCSON—**John Aguirre,** quality analysis engineer, Hughes Aircraft Co., has been appointed membership and ticket chairman.

Fred Solga, quality test engineer, Hughes Aircraft Co., has been appointed section publicity chairman.

Lewis Z. Gunn, formerly of Hughes Aircraft Co., has moved to Lockheed Aircraft Co., Missile and Space Division, Sunnyvale, Calif.

James Gill, Jr., formerly of Hughes Aircraft Co., has joined Lear Manufacturing Co., Santa Monica, Calif., as chief of quality and reliability.

. . . WACO—**J. McGilvray** is welcomed as a new member. He was recently employed at Rocketdyne as a quality control analyst.

. . . WASHINGTON, D.C.—**Gilbert Maton** has replaced **George Minton,** who resigned as chairman of the Professional Standards and Examining Committee.

In the September issue, IQC, Mr. Teunission's name should have been spelled with a "T" instead of the "P"—sorry, Jack.

. . . WINDSOR—The Fourth Annual All Day Forum, Windsor section, was held Nov. 26, in the new Cleary Auditorium and Convention Hall. **Ken Crew,** forum chairman, and his program committee did a terrific job.

A brief outline of speakers and topics is as follows:

Gordon Webster, General Motors Institute, Flint, Mich., A Basic Education Presentation of Statistical Techniques.

Harvey Charbonneau, General Motors Institute, Flint, Mich., An Education Course for More Advanced Theories.

Dr. **William Gaunt,** Strong Cobb & Co., Cleveland Ohio, Outlining the Organization, Objectives, and Responsibilities of QC Departments.

Maurice Lightstone, Chrysler Corp., Detroit, Mich., QC as a Management Tool to Maintain Quality and Reduce Costs.

Steve Adams, Wolverine Tube Division, Calumet & Hecla, Inc., Mich., What, Where, When, Who and How Approach to Quality Problems.

Prof. **George Odiorne,** University of Michigan, Ann Arbor, Mich., Human Reactions in the QC Organization and Discussion of Actual Problems.

The Panel topic — "Vendor Consumer Relations." Panel members—**Harmon Bayer,** Bayer, Kobart & Associates; **Neil McCarthy,** Canadian Westinghouse; **William Moggridge,** Canada Iron Foundry; **Robert Marshall,** H. J. Heinz Co.; **Jack Downey,** Chrysler Corp., Windsor; **Evan Reynolds,** and **Robert Wilson,** General Motors of Canada.

R. M. Gooderham, director, Canadian Welding Bureau, informed the guests, after a farm style luncheon, about the technological advances in Russia.

. . . WORCESTER—**Nasim David,** formerly with Sylvania Corp., is now quality manager with Jamesbury Corp., Worcester, Mass.

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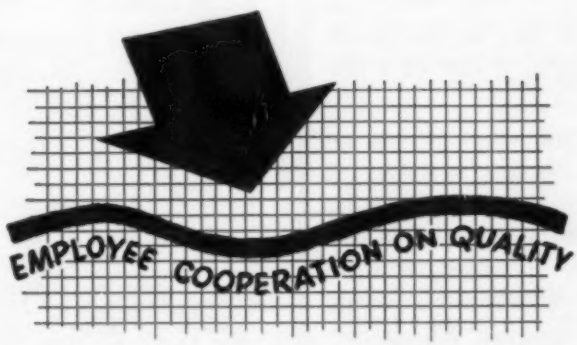

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WARD, BERNARD J., Toronto, Ont., Canada
WEISE, HERBERT R. JR., Little Rock, Ark.
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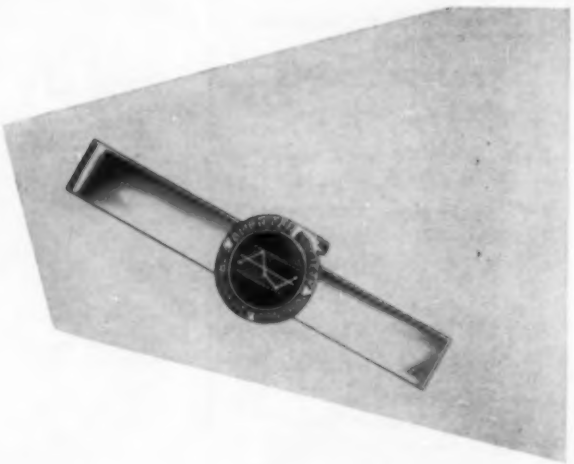

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clinics, conferences, and courses

JANUARY

. . . 26—One Day Seminar sponsored by the Hartford ASQC section at the Hotel Bond, Hartford, Conn. The speaker will be Dorian Shainin, Fellow ASQC, and vice president, Rath and Strong, Industrial Consultants. He will describe "Thirteen Ways to Reduce Inherent Avoidable Costs." Contact C. Chilone, Anemostat Corporation of America, 15 Frower St., Hartford, Conn.

. . . 28—Annual Inland Empire One Day Conference, Mission Inn, Riverside, Calif., sponsored by the San Bernardino ASQC section. Four simultaneous sessions will cover reliability, advanced statistical methods, process control and inspection work shop. Speakers will include Dr. I. West, Dr. H. Romig, Dr. Kuhn, W. M. Ferguson and L. Gideon. Contact Harold Batchelor, General Electric Co., Ontario, Calif., telephone YUkon 6-3861, Ext. 209.

. . . 28—10th Annual Quality Control Conference, Cincinnati, Ohio, sponsored by ASQC Cincinnati and Hamilton-Middletown sections. Topics include management relations to QC; QC in the bulk industries (food, chemicals, paper, etc.) and QC in mechanical and metal industries (hard goods, electronics, etc.), contact Hubert T. Cornish, 7276 Rita Lane, Cincinnati 43, Ohio.

. . . 29-Feb. 3—Winter General Meeting of the American Institute of Electrical Engineers, Statler-Hilton Hotel, New York City. Contact AIEE, 33 West 39th St., New York, N.Y.

. . . 30-Feb. 9—Fourteenth annual basic short course in QC by Statistical Methods presented by the Division of University Extension, University of Illinois, Urbana, Ill. The course is designed for those in the areas of design, production, procurement, management, quality control, and inspection. Contact Prof. John A. Henry, Mechanical Engineering Laboratory, University of Illinois, Urbana, Ill.

. . . 31—Sixteen week advanced course on statistical principles, rm. 213, University of Illinois, Navy Pier, from 7 to 10 p.m. Eligibility for enrollment can be established by consultation with the instructors—Dr. Marjorie L. Sutherland, Sutherland-Jacobson and Associates, and Mae-Goodwin Tarver, Continental Can Co. Those persons who satisfactorily completed the 1960 basic QC course are automatically eligible. The course is limited to 40 students and the fee will be nominal. Contact Miss Tarver at VI 6-7000, Ext. 450.

FEBRUARY

. . . 3-4—13th Annual Industrial Engineering Institute, Schoenberg Hall, UCLA campus, Los Angeles, Calif. A similar program will be held simultaneously in Berkeley. Contact Dept. K, University of California Extension, Los Angeles 24, Calif.

. . . 4—Chemical Division Conference, Seton Hall University, South Orange, N.J. Luncheon speaker will be Dr. Ellis R. Ott, Rutgers—The State University, New Brunswick, N.J., with "Applications of Statistics in the Chemical Industry." The program, which will open at 9:30 a.m., will include three panels—a sampling of elementary ideas in statistics; computer applications, analog and digital, and experimental design. Speakers include Dr. Churchill Eisenhart and Dr. J. Youden, National Bureau of Standards; Dr. Ott and Dr. Mason E. Wescott, Rutgers—The State University; Dr. Grant Wernimont, Eastman Kodak Co., and Consultants Cuthbert Daniel and Tom Budne.

. . . 9—Thinking Tools for Engineers Series for ten consecutive Tuesday evenings, location to be announced, sponsored by the Boston ASQC section, contact Robert Fabian, 256 Plain St., Rockland, Mass.

Short Courses in Quality Control

Usual Time Course is Held	*Type of Course*	*Where Held*	*Course Director*
Jan. 30-Feb. 9	Basic	University of Illinois, Urbana, Ill.	John A. Henry
Apr. 23.-May 5	Advanced	University of Connecticut, Storrs, Conn.	Richard M. Story, Jr.
May 19-26	Basic (Textile Ind)	North Carolina State College, Raleigh, N.C.	David B. Stansel
June 5-9	Basic (Graphic Arts)	Rochester Institute of Technology, Rochester, N.Y.	Harold Kentner
June 7-17	Design of Experiments	Purdue University, Lafayette, Ind.	Charles R. Hicks
June 11-23	Reliability Institute	University of Connecticut, Storrs, Conn.	Richard M. Story, Jr.
June 12-21	Basic (Chem. Ind)	Rochester Institute of Technology, Rochester, N.Y.	Harold Kentner
June 22-29	Advanced (Chem. Ind.)	Rochester Institute of Technology, Rochester, N.Y.	Harold Kentner
July	Basic	TAPPI Statistics Course, Queens University, Kingston, Ontario, Canada	.....
July	Advanced	TAPPI Statistics Course, Queens University, Kingston, Ontario, Canada	.....
July 31-Aug. 11	Statistical Methods In Industry	UCLA, Los Angeles, Calif.	Edward P. Coleman
August 21-31	Basic	University of Michigan, Ann Arbor, Mich.	C. C. Craig
September 5-15	Advanced	Purdue University, Lafayette, Ind.	Irving W. Burr
September 10-22	Basic	University of Connecticut, Storrs, Conn.	Richard M. Story, Jr.

. . 9-10—27th Meeting of the ASQC Metals Technical Committee with S. S. Lewis, Jones & Laughlin Steel Corp., Pittsburgh, Pa., as host. Contact T. P. Davis, Allegheny Ludlum Steel Corp., Watervliet Works, Watervliet, N.Y.

. . . 11—Annual ASQC Automotive Division Conference, Rackman Memorial Bldg., 100 Farnsworth Ave., Detroit 2, Mich. Contact Steve Adams, 18469 Dolores Ave., Lathrup Village, Michigan.

. . . 14—One Day Clinic at the Hotel Lowry, St. Paul, Minn., sponsored by the Minnesota ASQC section, contact Kenneth L. Sundeen, Minneapolis Honeywell Regulator Co., 2753 4th Ave. South, Minneapolis, Minn.

. . . 14-16—Second Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Texas, sponsored by South Texas section of the Society for Nondestructive Testing, Inc., and Southwest Research Institute. Contact R. B. Wangler, general chairman, Southwest Research Institute, Box 2296, San Antonio, Texas.

. . . 16-17—Eleventh Annual Conference of the Textile and Needle Trades Division, ASQC, at the Robert E. Lee Hotel, Winston-Salem, N.C. Contact the conference chairman—Jim Wheeler, Canton Cotton Mills, Canton, Ga.

. . . 17-18—Two Day Short Course in Fractional Factorial Experimentation, Chicago, Ill., with instructors Cuthbert Daniel and John Hromi. Contact John Gorman, Standard Oil Company of Indiana, Whiting, Ind.

. . . 18—All Day Conference sponsored by the South Texas section, ASQC. Contact Ed Franklin, 7722 Belbay, Houston, Texas.

. . . 20-22—1961 Conference for Business and Industry, Seattle, Wash., sponsored by the American Management Association. Contact AMA, 1515 Broadway, Times Square, New York 36, N. Y.

. . . 22—Second Annual Reliability Symposium, Statler Hilton Hotel, Los Angeles, Calif., sponsored by the Los Angeles ASQC section. For additional information contact Jack Lancaster, AMC Ballistic Missile Center (LBPQ) AF Unit Post Office, Los Angeles 45, Calif. Telephone ORchard 0-1444, Ext. 1153, or Steve Kozich, American Electronics, 1598 East Ross Ave., Fullerton, Calif. Telephone TRojan 1-3020 or MAdison 5-7192. The Conference Transaction will be printed and copies can be reserved by writing to Arnold Rothstein, Space Technology Laboratories, 5800 Arbor Vitae, Los Angeles 45, Calif. Telephone SPring 6-1311, Ext. 1002.

. . . 20-23—46th Annual Meeting of the Technical Association of the Pulp and Paper Industry, Hotel Commodore, New York, N.Y. Contact TAPPI, 360 Lexington Ave., New York 17, New York.

MARCH

. . . 4—Fifth Dayton Quality Control Conference, Biltmore Hotel, Dayton, Ohio, sponsored by the Dayton section, ASQC. Contact John E. Condon, Military Development Department, National Cash Register Co., Main and K Streets, Dayton 9, Ohio.

. . . 5-9—Sixth Annual Gas Turbine Conference sponsored jointly by the Gas Turbine Power Division of the American Society of Mechanical Engineers and the U.S. Department of Defense at the Shoreham Hotel and the Pentagon, Washington, D.C. Contact ASME, Meetings Department, 29 West 39th St., New York 18, New York.

. . . 6-8—Data Processing Conference, Statler Hilton Hotel, New York City, sponsored by the American Management Association. Contact AMA, 1515 Broadway, Times Square, New York 36, N. Y.

. . . 8-10—11th Annual ISA Conference on Instrumentation for the Iron and Steel Industry, Roosevelt Hotel, Pittsburgh, Pa. Contact Richard R. Webster, Jones & Laughlin Steel Corp., Research Laboratory, 900 Agnew Ave., Pittsburgh 30, Pa.

. . . 10—Joint ASQC-AIIE Seminar "The Breakthrough to Higher Levels of Performance," Western Skies Hotel, Albuquerque, N. M. Contact Joe McDowell, 604 Amherst Dr., S. E., Albuquerque, N.M.

. . . 11—All Day Annual QC Forum sponsored by the Toronto ASQC section, contact G. E. Culver, 78 Hearst Circle, Toronto, Ontario, Canada.

. . . 13-14—EVOP (Evolutionary Operations) Course, Disneyland Hotel, Anaheim, Calif., sponsored by the Los Angeles section, ASQC, and the Chemical Division, ASQC. Instructors will be Paul Tidwell, Monsanto Chemical Co., and Robert Hunter. This course immediately precedes the Western Regional Conference at the same location. Course fee—$100, payable to EVOP Course, L.A. Contact A. A. Rothstein, c/o Space Technology Laboratories, Bldg. 4, Rm. 191, 5730 Arbor Vitae St., Los Angeles 45, Calif.

. . . 15-17—Western Regional Conference, Disneyland Hotel, Anaheim, Calif. Conference immediately follows an EVOP course, Mar. 13-14, at the same location. Contact C. L. Kleppsattel, Hughes Aircraft Co., Newport Beach, Calif.

. . . 17—Eighth Annual Industrial Clinic for Quality Control sponsored by the Milwaukee ASQC section. Topics include foods and allied industries, inspection and gaging, management, and general interest, plus a top-notch series of training sessions. Contact Riley Kelhofer, P. O. Box 1204, Milwaukee 1, Wis.

. . . 20-24—Twelfth Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif., sponsored by American Society for Metals, Metals Park (Novelty), Ohio.

. . . 27-31—3rd Symposium on Temperature—Its Measurement and Control in Science and Industry, Veterans' Memorial Hall and Deshler-Hilton Hotel, Columbus, Ohio. Sponsored by ISA, American Institute of Physics, and National Bureau of Standards. Contact ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

. . . 28—17th Annual Quality Control Clinic, University of Rochester, Rochester, N.Y., sponsored by the Rochester section, ASQC. Contact Albert D. Rickmers, associate professor, College of Graphic Arts and Photography, Rochester Institute of Technology, 65 Plymouth Avenue South, Rochester 8, N.Y.

APRIL

. . . 6-8—Sixth ASQC Workshop-Seminar, Hotel Roosevelt, New York City, Paul C. Clifford, director, professor at Montclair State College. Address inquiries to: Sixth ASQC Workshop-Seminar, ASQC, 161 W. Wisconsin Ave., Milwaukee 3, Wis.

. . . 12-13—Third Symposium on Information and Decision Processes, Purdue University, Lafayette, Ind. Contact Purdue University.

. . . 15—Opening day of a 30 day showing of "Plastics—A New Dimension in Buildings," in Springfield, Mass., the first educational and technical traveling exhibit of the Society of Plastics Engineers. The exhibit will travel to some 16 major North American cities for 30-day showings during 1961-63. This educational exhibit is designed to disseminate technical information to architects, builders, contractors, interior designers and students in these professions. A one-day SPE Regional Technical Conference on the same subject will be held in Springfield, Mass., Apr. 20. Contact Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

. . . 17-19—7th National ISA Symposium on Instrumental Methods of Analysis, Shamrock-Hilton Hotel, Houston, Texas. Contact ISA, 313 Sixth Ave., Pittsburgh 22, Pa.

. . . 19-21—13th Annual Southwestern Institute of Radio Engineers Conference and Region Six IRE meeting, Dallas Memorial Auditorium and the Baker Hotel, Dallas, Texas. Contact Hal Copeland, 814 Wilson Bldg., Dallas 1, Texas.

. . . 23-27—63rd Annual Meeting, The American Ceramic Society, Royal York Hotel, Toronto, Canada. Contact The American Ceramic Society, Inc., 4055 North High St., Columbus 14, Ohio.

. . . 23-May 5—Advanced QC Course, University of Connecticut, Storrs, Conn., contact Richard M. Story, Jr., University of Connecticut, Storrs, Connecticut.

. . . 30-May 4—7th National Aero-Space Instrumentation Symposium, Adolphus Hotel, Dallas, Texas. Contact W. J. Gabriel, Group Engineer, Convair Division, General Dynamics Corp., Fort Worth, Texas.

MAY

. . . 9-11—1961 Western Joint Computer Conference, Ambassador Hotel, Los Angeles, Calif. Papers on systems, applications and circuitry for both digital and analog computers. Submit summaries of papers by Dec. 15 to C. T. Leondes, associate professor of engineering, Department of Engineering, University of California, Los Angeles 24, Calif.

. . . **11-13**—12th Annual National Conference and Convention, American Institute of Industrial Engineers, Inc., Sheraton Cadillac Hotel, Detroit, Mich. Contact James E. McCartney, 12th Annual AIIE Conference, Rm. 29, 4181 Oakman Blvd., Detroit 4, Mich.

. . . **14-17**—Spring Meeting, National Fluid Power Association, The Greenbrier, White Sulphur Springs, W. Va. Contact NFPA, 5595 N. Hollywood Ave., Milwaukee 17, Wis.

. . . **19-26**—Basic QC Course for the Textile Industry, North Carolina State College, Raleigh, N.C. Contact David B. Stansel, North Carolina State College of Agriculture and Engineering, Division of College Extension, P.O. Box 5125, Raleigh, North Carolina.

. . . **22-26**—Annual Conference of the Society of Photographic Scientists and Engineers, Arlington Hotel, Binghamton, N.Y. Contact SPSE, Box 1609, Main Post Office, Washington, D.C.

JUNE

. . . **5-9**—Basic QC Course for the Graphic Arts Industry, Rochester Institute of Technology, Rochester, N.Y., contact Harold Kentner, Director, Extended Services, RIT, Rochester, New York.

. . . **7-17**—Design of Experiments Course, Charles R. Hicks, instructor, Purdue University, Lafayette, Ind., contact Statistical Laboratory, Engineering Administration Bldg., Purdue University, Lafayette, Indiana.

. . . **11-23**—Reliability Institute, University of Connecticut, Storrs, Conn., contact Richard M. Story, Jr., University of Connecticut, Storrs, Connecticut.

. . . **12-21**—Basic QC Course for the Chemical Industry, Rochester Institute of Technology, Rochester, N.Y., contact Harold Kentner, Director, Extended Services, RIT, Rochester, N.Y.

. . . **13**—Fourth Graduate Summer Program of Statistics in the Health Sciences, June 13 through July 28, University of Minnesota. Persons interested in course work in elementary or advanced statistics, vital records, records management, design of experiments, bioassay, sampling, demography, and statistical aspects of nutrition research, genetics, pharmacology and mathematical models are invited to attend. Stipends are available to qualified students. Experts such as Cochran, Cox, Li, Chiang, Bailey, Patton, and others will be teaching. Housing, food and course fees will be about $300. Contact Biostatistics, 1226 Mayo, University of Minnesota, Minneapolis 14, Minn.

. . . **15**—Southern Regional Graduate Summer Session in Statistics, Virginia Polytechnic Institute, Blacksburg, Va., June 15 through July 22. The Virginia Polytechnic Institute, Oklahoma State University, North Carolina State College, and the University of Florida have agreed to operate a continuing program of graduate summer sessions in statistics to be held at each institution in rotation. The session will last six weeks and courses will carry five quarter hours of credit. Not more than two courses may be taken for credit at any one session. The summer work in statistics may be applied as residence credit at any of the cooperating institutions, as well as certain other universities, in partial fulfillment of the requirements for a graduate degree. Courses are Statistical methods, sampling theory; applied statistics for engineers and physical scientists; theory I, probability; theory II, statistical inference; theory III, theory of linear hypotheses; non-parametric methods and multivariate methods. A number of courses in advanced mathematics will be available during the summer session. A series of Colloquia involving recent developments in statistical theory and methods will be conducted during the special summer session. Requests for application blanks and for fellowships should be addressed to Dr. Boyd Harshbarger, Head, Department of Statistics, Virginia Polytechnic Institute, Blacksburg, Va.

. . . **22-29**—Advanced QC Course for the Chemical Industry, Rochester Institute of Technology, Rochester, N.Y., contact Harold Kentner, Director, Extended Services, RIT, Rochester, New York.

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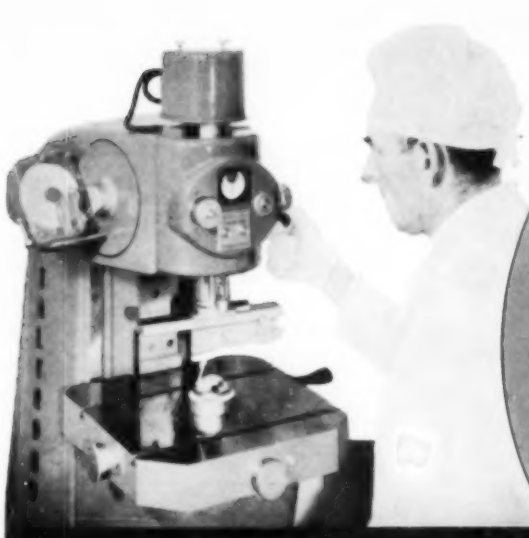

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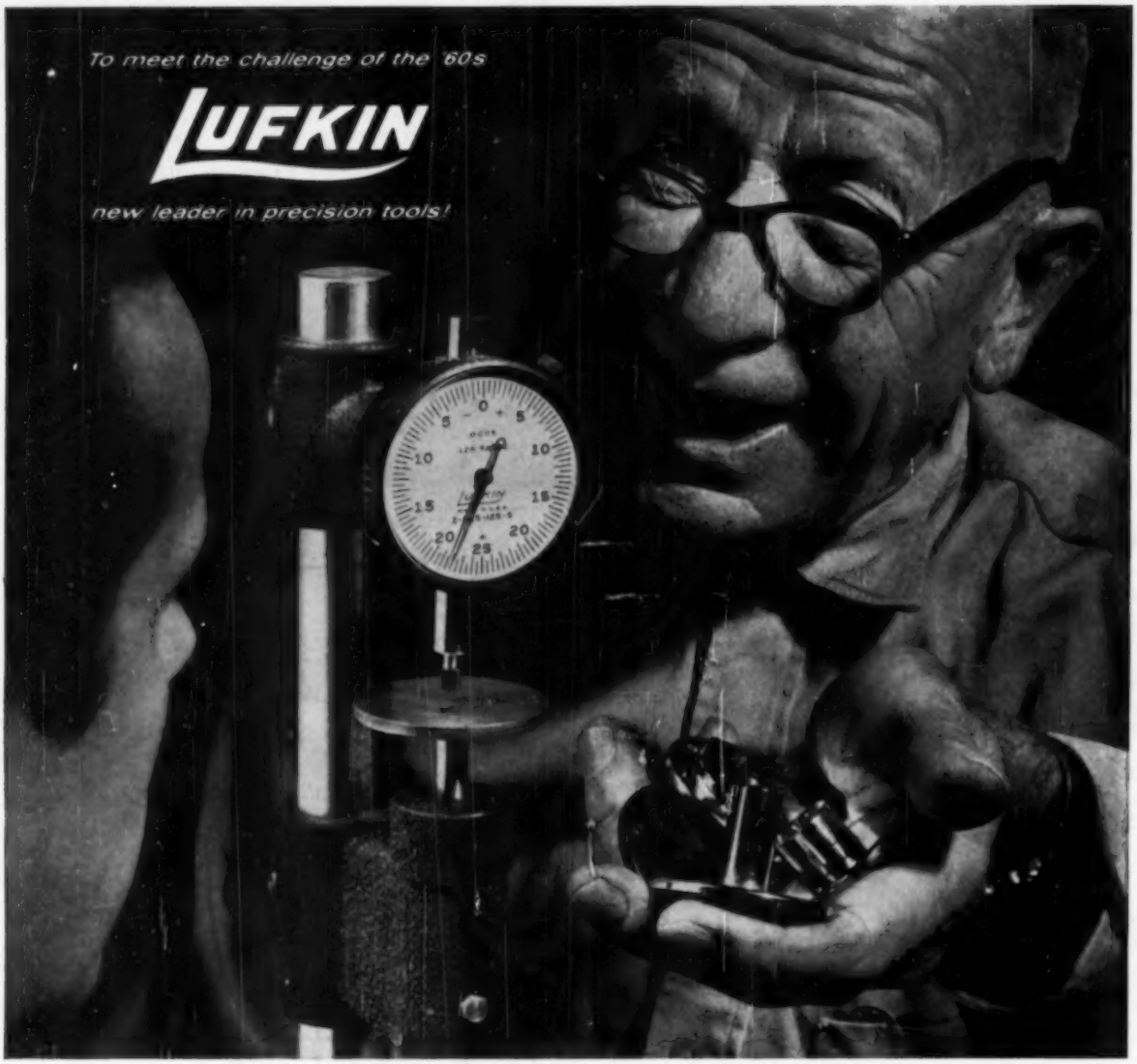

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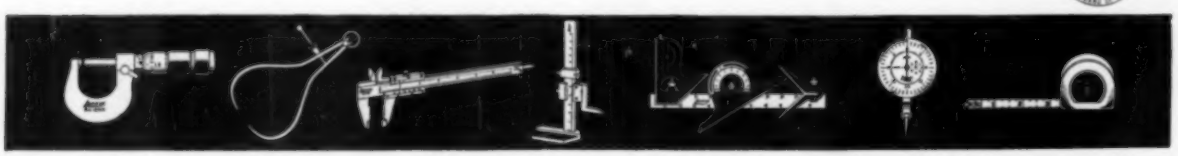
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